(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
10 April 2003 (10.04.2003)

PCT

(10) International Publication Number
WO 03/030092 A1

(51) International Patent Classification[7]: G06K 11/18

(21) International Application Number: PCT/NO02/00309

(22) International Filing Date:
3 September 2002 (03.09.2002)

(25) Filing Language: Norwegian

(26) Publication Language: English

(30) Priority Data:
20014305 4 September 2001 (04.09.2001) NO
20021056 1 March 2002 (01.03.2002) NO

(71) Applicant and
(72) Inventor: **BADARNEH, Ziad** [NO/NO]; Carl Kjelsens vei 34, N-0874 Oslo (NO).

(74) Agent: **LANGFELDT, Jens, F., C.**; Bryns Zacco AS, P.O. Box 765, Sentrum, N-0106 Oslo (NO).

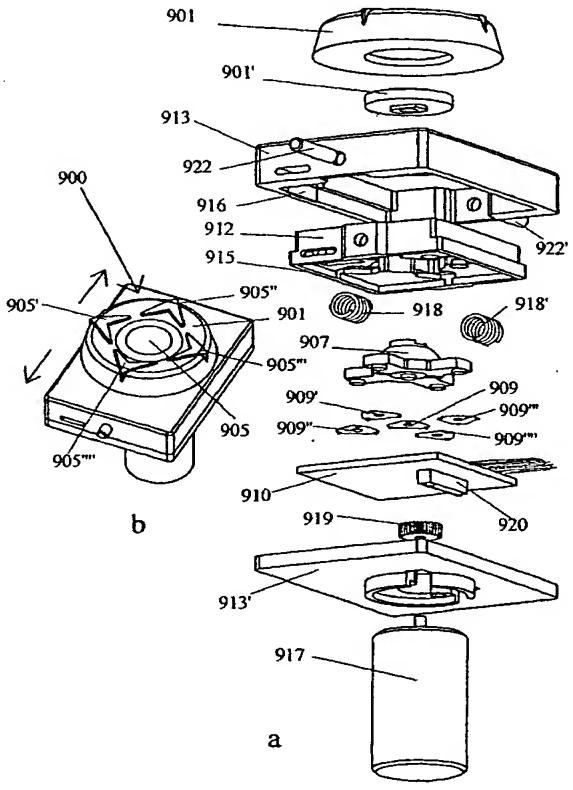
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

[Continued on next page]

(54) Title: OPERATING DEVICE FOR CONTROLLING FUNCTIONS IN ELECTRONIC EQUIPMENT



(57) **Abstract:** An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the operating device has a control element having four tilting positions and central depression, with movement on rotation or sliding in at least two directions, where there is a means for force feedback, wherein the movement is actuated by an electromotor or step motor for initiating or simulating a "step feeling", and wherein the angular extent of the movement, or the slide extent of the movement, and speed of the movement are measured, and where the "step feeling" will be able to vary in frequency because of the extent of movement. The motor is designed to perform operations selected from the group: controlling the number of steps, controlling the distance between steps, controlling the force a user needs to apply, braking or stopping movement of the control element, causing a back or return is movement, stimulating or oscillating (small reciprocating motions), detecting movement and direction of movement.

WO 03/030092 A1

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

OPERATING DEVICE FOR CONTROLLING FUNCTIONS IN ELECTRONIC EQUIPMENT

The present invention relates to an operating device as disclosed in the preambles of attached claims 1, 6, 8-12, 14, 16, 19, 22, 24, 26, 27, 31, 42, 44-48, 50, 56, 58, 62, 66, 67, 68, 69, 76, 80, 89, 94, 102, 106, 110, 112, 113, 117, 119, 121, 124-128, 140 and 141.

This application describes new solutions and combinations in relation to operating devices or so-called multifunction switches for use in connection with electronic apparatus which preferably have a display, and control of means of transport and functional equipment with or without the assistance of electronic technology or means of display. The invention is related, *inter alia*, to a technique that is often referred to as force feedback in order to be able to simulate movements or give feedback in the form of pulses for executed operations in connection with the use of multifunction switches, or optionally in association with a touch screen.

The background for the invention is, *inter alia*, the desire for improved and easier operation of electronic equipment and to have a minimum number of switches to deal with. Thus, the object of the invention is the provision of operating devices which will be particularly suitable for use in equipment which has or is used in connection with a display screen, such as various handheld or fixed apparatus, for example, telephones, mobile telephones, PDAs, mini-computers (PCs), multi-communicators, photographic and foil equipment, radios, access and control equipment, calculators, program testing and analysis equipment, music centres, and remote control for all types of apparatus and functions. It is precisely with these apparatus that simple, readily understandable functionality in connection with the operating devices is a major object of the present invention.

It is common knowledge that small and also portable apparatus are developing rapidly, and therefore many typical product groups have started to adopt techniques from one another by combining several applications in one and the same apparatus. A typical example of this are known as multi-communicators or smart phones, which are a combination of a mobile telephone, a PDA, a PC and in some cases a camera too. All these types of apparatus make use of a display screen with the aid of which it is possible to control the apparatus, but in today's situation this involves the use of an increasing number of so-called press switches.

The Applicant's earlier international patent applications, PCT/NO96/00282, PCT/NO99/00373, PCT/NO00/00372, and PCT/NO01/00057 describe specific switch solutions, PCT/NO00/00412 and parts of PCT/NO01/00056 relate to an interactive system adapted to electronic equipment and interactive use of different types of multifunction switches for electronic apparatus such as those in a vehicle. The first-mentioned four patent applications teach, *inter alia*, that by means of a so-called toggle function, the switch can be moved in different directions without remaining in the fixed positions, but rather returning to a starting point.

One of the objects in connection with the present invention is to provide a number of switch solutions that can replace traditional push-button keyboards. Some of these solutions are also taught in the aforementioned earlier applications . In some cases, the sliding and pressure-operated switches disclosed in these earlier applications have physical feedback when in use in that steps in the sliding movement move springs which a user will feel via the control element or switch button of the switch during use. However, the present invention will allow the step movement to be simulated and given a characteristic, customised "user profile".

The solutions described according to the present invention represent to a certain extent a further development of these previously described solutions and provide some concrete examples of the use of the inventor's multifunction switches, e.g., for use in a car.

International Application PCT/NO01/00056 teaches the use of multifunction switches mounted, for instance, on a steering wheel. The combination of a movable multifunction switch and interactive display functions is also illustrated and described. The application focuses in particular on a multifunction switch having three pressing functions, and the combination of two multifunction switches. A sliding switch with four pressure positions is also shown.

The technical solutions of rotating multifunction switches and sliding switches will be taught further in connection with the present invention. It will also be shown how the invention allows advanced, but easily operatable multifunction switches to be made and used, for example in a force feedback system. This represents a significant aspect of the applications of multifunction switches, with a view to allowing a user to have finger-perceptible feedback from a system of which the multifunction switch is an integral part

and associated with the movement of the control element on a multifunction switch of this kind.

In connection with so-called force feedback with pulses, reference will be made to US Patents 5643087, 5742278 and 6036495 in order to illustrate some of the prior art. In the case of a so-called joystick, electric motors are used which give feedback to a movement of the joystick handle. These motors are usually connected directly to the handle and can control or actuate the movement in an X/Y direction.

The present invention will focus on, *inter alia*, the structure of a roller switch for force feedback, and rotatable switches having five pressure points, and centre point deviation control also for force feedback. A sliding switch having five pressure points will also be shown.

Another object of the present invention is to allow the manufacture of switches which give physical feedback to a user without the control element on the switch itself (operating device) having to move to any appreciable extent. The starting point in this case consists of solutions which can simulate movements that the earlier solutions have had.

The multifunction switches and switch combinations used are not intended to have fixed marking, as for instance by using silk screen printing. All the information the user needs is intended to be shown on a display means. In other words, the intention is that the multifunction switch should be able to operate interactively with a menu system shown on a display screen, for example, a LCD screen.

In electronic apparatus, the multifunction switches could replace the traditional keyboard or keypad, or be a supplementary element, for example, for navigation. The user will then be able to operate the apparatus and its functions by rotating or sliding and pressing the multifunction switch in interaction with what is shown on the screen. It will be easy to see the advantage of using such a multifunction switch mounted in a remote control unit in connection with the use of TVs, projectors and the like.

In the case of vehicle, the multifunction switches can be mounted on the steering wheel, control lever, centre console, sides panels, doors and the like, or function together with a handheld apparatus such as a remote control unit. The display component in a vehicle can, for example, be located in connection with the dashboard in a car, or in proximity

thereto, so that the driver can easily see the display whilst driving, but without the driver thereby being distracted from constantly assessing the traffic. Of course, in another variant the information could be projected onto the windscreen, as is known from fighter planes, for instance. For use by persons other than the driver of the vehicle, it is conceivable to place a display in a centre console in the front of the car, or immediately in front of a passenger. An alternative location here could be in the back of a front seat for back seat passengers, or in the roof, then optionally as a folding solution.

Another object of the present invention is to describe and show in some detail the structure and the function of the multifunction switches associated with a technique often referred to as force feedback, abbreviated to FF, to be able to simulate movements or give feedback in the form of pulses for executed operations in connection with the use of multifunction switches.

In summary, the invention therefore relates to the function and structure of, *inter alia*, rotary or sliding multifunctional switches and switch combinations having three to five depression positions for use in handheld or fixed electronic apparatus and/or means of transport which have or are connected to display elements for function control.

In addition and as indicated, the present invention will also relate to a number of switch solutions which represent major further developments of the solutions previously described by the Applicant.

The following figures will describe the general idea of the use of multifunction switches, and in particular applications that would be useful in connection with their use in vehicles.

However, any person of ordinary skill in the art will understand that the solutions illustrated and described can be used in all forms of electronic equipment connected to display functions.

The invention will now be described in more detail in connection with non-limiting exemplary embodiments of the invention shown in the figures.

The switch devices shown are referred to as "operating device" or "multifunction switch". These are intended for the control of user functions in electronic user

equipment in interaction with a display screen. The interaction will be better understood in connection with the discussion of Figure 64.

The characteristic features of the invention are set forth in the characterising clauses of the aforementioned operating device claims 1, 6, 8-12, 14, 16, 19, 22, 24, 26, 27, 31, 42, 44-48, 50, 56, 58, 62, 66, 67, 68, 69, 76, 80, 89, 94, 102, 106, 110, 112, 113, 117, 119, 121, 124-128, 140 and 141, and the subsidiary claims that are linked to each of these said independent claims.

The invention will now be described in more detail with reference to the attached figures which show various embodiments of the invention.

Figs. 1a-d show a solution known from International Application PCT/NO01/00057.

Figs. 2a-2c show a modification of the solution shown in Fig. 1 with two switches in cooperation.

Figs. 3a and 3b show an alternative solution to that shown in Fig. 2.

Figs. 4a-4d show a substantial modification of a rotary pressure switch as disclosed in International Application PCT/NO01/00057.

Figs. 5a-5c show a rotary pressure switch with pulse generator for two-way movement, whilst Fig. 5d is an exploded view of this switch.

Figs. 6a-6d show a modified roller switch.

Figs. 7a-7c show the use of magnets or electromagnets in connection with a rotary switch.

Figs. 8a and 8b show the use of magnets or electromagnets for marking stepwise notches in connection which a sliding switch.

Figs. 9a-9e show an embodiment related to a sliding and pressure switch with catch springs.

Figs. 10a-10f show a so-called toggle switch.

Figs. 11a-11j show a sliding switch with five-point pressing. Figs. 11k-11m show a modification of the solution.

Figs. 12a-12d show a sliding switch with five-point pressing, and Fig. 12e shows a switch with the property of rotation.

Figs. 13a-13f also show a sliding switch with five-point pressing.

Figs. 14a-14d show a rotary switch with five pressure points.

Figs. 15a-c show a rotary switch with a fixed centre portion which has five pressure points and an outer part with four pressure points.

Figs. 16a-16d show a rotary switch with five pressure points, whilst the version shown in Figs. 16e-16i is the rotary switch made having four pressure points, and where Fig. 16e is an exploded view of the switch.

Fig. 17a is a perspective view of a roller switch equipped with three pressure points; Figs. 17b-17j show more details of this switch and its three pressure points; and Figs. 17k, 17l show more details on connection with a switch construction of this type.

Figs. 17m-17o show a special modification of the switch solution shown in Figs. 17a-17j.

Figs. 18a-d show a cylinder switch with pressure switches mounted.

Figs. 19a-19d show a basic structure of a cylinder or roller switch in a "cross" variant.

Figs. 20a-20d show a roller switch with at least three pressure points and encircled by a horizontal rotary switch.

Figs. 21a-21c show a rotary switch with a toggle function.

Figs. 22a-22d show a belt-based switch construction, where Figs. 22c and 22d show alternative locations of pressure points, and Figs. 22e-22g show more details of the construction.

Figs. 23a-23c, Figs. 24a-24c, Figs. 25a-25c, Figs. 26a-26c, Figs. 27a-27c and Figs. 28a-28c show alternative embodiments of the actual control element for an operating device according to the invention.

Figs. 29a and 29b show an embodiment where a control element in the form of a roller is immobilised when depressed for prevention of rotation.

Fig. 30 shows a roller switch with physical means for stopping rotation on depression.

Figs. 31a-31c show a clamp solution according to the principle shown in Fig. 29 for a horizontal rotary switch.

Fig. 32 shows a sliding switch that is lockable on depression.

Fig. 33 shows a sliding switch whose control element is prevented from being moved on depression.

Figs. 34a-34b show a horizontally arranged rotary switch which on depression is locked against further rotation.

Fig. 35a and Fig. 35b show a variant of the solution shown in Fig. 11, but equipped with a roller-shaped control element.

Figs. 36a-36g show a variant of a roller switch.

Fig. 37 shows a roller switch designed for force feedback.

Fig. 38 shows a variant of the solution shown in Fig. 37, but with a horizontal, rotatable control element.

Fig. 39 shows the principle for a roller switch with force feedback.

Fig. 40 shows a second roller switch where an electromotor is used.

Figs. 41a and 41b, and Figs. 42a and 42b, show a principle, known per se, in connection with a step motor.

Fig. 43 and Fig. 44 show variants of the solution shown in Figs. 41 and 42.

Fig. 45 shows in principle a practical embodiment of an operating device in connection with the use of the properties of a step motor.

Figs. 46a-46c show a three pressure point roller switch with a built-in electromotor or step motor.

Figs. 47a-47e show a roller switch in which an electromotor is incorporated, and Figs. 47f-47u show variants thereof.

Figs. 48a-48f show alternative principles for detection of rotation.

Figs. 49a-52b show transmission of force to a roller switch.

Figs. 53a-53c show delivery of force for a five pressure point rotary switch.

Figs. 54a-54e show a four pressure point rotary switch with direct axial force connection.

Fig. 55 shows a five pressure point rotary switch as shown in Fig. 11 with axial motor.

Figs. 56a-56d show a five pressure point rotary switch.

Figs. 57a-57c show another solution for a five pressure point rotary switch.

Figs. 58a-58d show a four pressure point rotary switch with a central pressure-operated switch which also has a centre position deviation function.

Figs. 59a-59d show a rotatable belt switch with five pressure point function.

Figs. 60a-60g show variations of Fig. 59, and Figs. 60h-60yy show additional variants.

Figs. 61a-61e show in principle variations in detection and cooperation between the rotating elements in belt switch.

Fig. 62a-62b show a roller switch with activation sensors.

Fig. 63 shows a solution for a stop function.

Fig. 64 illustrates the connection between the switch and different elements in an environment of use.

Figs. 65a-65b show a solution for a five pressure point sliding switch.

Figs. 66a-66c show a five pressure point, stepwise movable sliding switch connected to an electromotor for force feedback (FF).

Fig. 67 shows a five pressure point sliding switch with elements for force feedback.

Figs. 68a-68b show a five pressure point sliding switch with a force feedback system.

Figs. 69a-69b show a five pressure point rotary switch with a force feedback system.

Figs. 70a-70d show a rotary switch with sliding motion.

Figs. 71a-71d show variations of a roller switch with a force feedback system.

Figs. 72a-72c show another variation of a roller switch with a force feedback system.

Figs. 73a-73b show yet another variation of a roller switch with force feedback system.

Figs. 74a-74b show a variation of a belt switch.

Figs. 75a-75c show a detection and step solution for roller and rotary switches.

Figs. 1a-1d show a solution known from International Patent Application PCT/NO01/00057 consisting of a sliding switch having a depressible control element 1 which is designed on selective depression to actuate at least one of a plurality of switches 2, 3, 4, 5, and where the control element is movable, as shown in Fig. 1a, either towards the right or towards the left against the spring action of respective springs 6, 7, and where at respective end positions there are pulse generators 8, 9 to simulate a step movement. These pulse generators may, for example, function magnetically,

although this should not be regarded as a limiting the scope of the invention. As can be seen from the non-limiting embodiment in Fig. 1c, repeated movements to the right will indicate respectively one, two, three four and five movement steps. However, the number of steps is not limited to only five. An alternative solution as regards movement pattern is shown in Fig. 1d.

Fig. 2a shows an operating device 10 for controlling user functions in electronic user equipment in interaction with a display screen (not shown), where the device has a control element 11; 12 which is mounted on a slide 13; 14 and which is movable in a first or second direction along a first axis against the action of spring force, as shown in connection with Fig. 1, where the slide 13; 14 at an end point for movement is designed to cooperate with a pulse generator 15, 16; 17, 18 for simulation of an intermittent or step movement. As shown, the control element is provided with a plurality of pressure points for actuating respective switches 19-22; 23-26 located on the slide on tilting or depression of the control element 11;12. However, in addition to the solution shown in Fig. 1, the slide is movable in a third or fourth direction in a second axial direction which forms an angle of 90° with the first axial direction, and against the action of the spring force provided by respective springs 27, 28; 29, 30, where respective slides 13; 14 at end points for such movement are designed to cooperate with a pulse generator 31, 32; 33, 34 in order to simulate an intermittent or step movement.

Figs. 3a and 3b show a variant of the solution indicated in Fig. 2. In this case, the slide is divided into a first part 35 and a second part 36 which engage with one another in a feather 37 and tongue 38 configuration, and where a respective first control element 39 and second control element 40 are tiltably arranged relative to their slide part, for example as shown in Figs. 1b and 2c. In a first axial direction (parallel to the short side of the drawing sheet), the two parts 35, 36 are movable either together in said first or second direction, or the first part 35 is movable alone in the first direction (to the left) and the second part is movable in the second direction (to the right). In the second axial direction the two parts are movable independent of one another. At end points for its movement, each slide part 35, 36 is designed for cooperation with a respective pulse generator 41; 42; 43 and 44; 45; 46. Springs 46-48 and 49-51 are associated with respective slides 35, 36 and provide resistance in connection with the sliding movements. Switches 52-54 are arranged on the control element 35, and switches 55, 56, 57, and 58 are arranged on slide part 36 and are activated on selective depression of the control elements 39, 40. It should also be noted that the switch 56 which is closest

to the first control element 39, and thus the first slide part 35, is designed to also serve as a fourth switch for the first slide part 35.

The solution shown in Figs. 4a-4d differs from the solution which can be seen in particular from Fig. 2b in that the control element, indicated in these figures by the reference numeral 59, is stepwise rotatable about a shaft 60 on the slide 61. The stepwise movement is caused by a toothed rim 62 which cooperates with a spring means 63. Depression of the control element 59 at particular pressure points will activate respective switches 64-67. Contact points 68 (of which only one is indicated), with the aid of ball means 69, 70, cause the individual steps of rotation to be detected. The control element 61 is, relative to that shown in Fig. 4c, movable against the action of springs 71, 72 and 73, 74 either to the left or the right or up/down for activation of respective pulse generators 75, 76, 77 and 78.

The operating device which can be seen from Figs. 5a-5d will be explained in more detail. Fig. 5a represents a central section of the operating device shown in Fig. 5c in the vertical direction of the drawing sheet, whilst Fig. 5b represents a central cross-section parallel to the short side of the drawing sheet. In this embodiment, there is also a control element 79 that is mounted on a slide 80 which is movable in a first or second direction along a first axis against the action of respective springs 81, 82, where the slide 80 at the end point for movement is designed to cooperate with a respective pulse generator 83; 84 in order to simulate an intermittent or step movement. The control element is provided with a plurality of pressure points (not shown) for selectively actuating switches 85-88 on tilting or depression of the control element, these switches being located on the slide 80. The control element 79 is stepwise rotatable about a shaft 89 on the slide, and the stepwise position of the control element 79 can either be detected by means of sliding contacts 91, 92 which are arranged to stepwise short-circuit contact points 93, 94, 95, 96, 97 on the slide, or can be detectable by means of contact balls, like those just described in connection with Fig. 4c and the references 68-70. Although it is not shown in Fig. 5, the slide 80 may be movable in a third or fourth direction in a second axial direction which forms an angle of 90° with the first axial direction and against the action of spring force, where at an end point for such movement the slide 80 is designed to cooperate with a pulse generator for simulation of an intermittent or step movement. Thus, the solution shown in Fig. 5c has a number of essential features in common with the solution shown in Fig. 4c.

On a closer study of Fig. 5d it will be seen that the stepwise movement is provided by means of two spring-loaded blocks 98, 99 which are mounted in a support 100, and where the support fits into an engaging part 101 which on its inside circumference has a polygonal shape as indicated by the reference numeral 101'. In this way, the elements 98, 99 will move stepwise into abutment with respective, opposite corners on the inside surface 101'.

The solution of the operating device shown in Fig. 6a has a spring-supported body 102 that is supported relative to the housing 103 of the operating device. The body 102 is designed to actuate a respective switch 104, 105, 106 on central depression or downward tilting at a respective end portion. As shown in Figs. 6a and 6c, the body 102 has at an upper portion thereof a circular sector cross-section. A semicircular control element is arranged to ride on said upper portion 102' and is slidably movable on this portion transverse to the longitudinal axis of the body 102 between two end positions. At a respective end position, the control element 107 is designed to activate a switch or force feedback means 108, 109. This is thus used to simulate rotation over notches or steps. The support of the body 102 is effected via a support bracket 110 which extends through the body 102. This can be seen in particular from Fig. 6b and Fig. 6d. It will thus be seen that this support is provided with a certain clearance, so that tilting at the end points of the control element causes tilting about the support 110.

Fig. 7 shows an operating device arrangement where the device has at least one control element 112 that is rotatable relative to the device housing 111 and designed on depression or tilting to operate various switch functions (not shown). In this embodiment, magnets or electromagnets 113 in stepwise arrangement are mounted on said housing or on a depressible carriage 115 in the housing which is supported by switches that operate the said switch functions, so that on turning cooperation with a magnetic means 114 on the control element is generated during rotation of the control element for indicating the stepwise movement of the control element 112.

A variant of the solution just described is found in Figs. 8a and 8b. Here, there is a slide 116 with a control element 117 that is designed on depression and/or tilting to operate various switch functions (not shown). It will be seen that stepwise positioned magnets or electromagnets 118 are arranged on the slide housing 119, or optionally on the slide, in order on movement of the slide 116 to cooperate with magnetic means 120 on the slide in the housing for indication or detection of the stepwise movements which can be made with the slide and also the position of the slide relative to the housing 119.

Figs. 9a-9d show an operating device which has a stepwise movable slide 121 with a control element 122 that is designed on depression and/or tilting to operate various switch functions that are provided by contact foil portions 123-127 on the device housing and located under the slide. Arms 138, 139, 140 and 141 are connected to the control element operating button 122 in order on activation thereof via the arms and catch springs 142-145 to actuate a respective contact foil portion via ends on a spider 146 which is movable together with the slide 121. Located at at least one end of the slide path of the slide 121 is a so-called toggle spring 147 for providing on movement of the slide 121 against the action of the spring, via said contact foil 123-137, a so-called kick switch function. Fig. 9e shows a typical design of the control element operating button, although this version is not necessarily limiting for the embodiment shown in Fig. 9 in its entirety.

Fig. 10 shows an operating device arrangement for controlling user functions in electronic user equipment in interaction with a display screen (not shown) where the device has a slide 148 having a control element 149 which when tilted and/or depressed causes activation of switch functions provided by switches 150, 151, 152 and 153. The slide 148 is movable from a neutral position, as shown in Fig. 10b, to opposite extreme positions, and a return spring device 154 is arranged to cause the slide 148 to be moved from an extreme position back to the neutral position, as shown in Fig. 10b. Arranged on the slide is a spring device which follows the movement of the slide, as for instance a cruciform spring 155, which is arranged to cooperate with contact points 156-159 arranged on the device housing 160, this cooperation occurring at respective extreme positions, as shown for instance in Fig. 10f. The said contact points 156-159 may, for example, be on a contact foil.

Another operating device can be seen in Fig. 11. The device has a control element 161 which is arranged on a slide 162, the slide being movable stepwise on engagement between spring-loaded pins 163, 164 and a corrugated or toothed part 163', 164' on the operating device housing. The control element has a plurality of pressure points, e.g., four, for selectively actuating switches 165 (see Fig. 11f) arranged on the operating device housing on tilting or depression of the control element. This switch should be capable of detecting five pressure possibilities. Central depression is detected by means of one or more switches 175, 177, 179, 181 (Fig. 11e); 187, 189, 191, 193 (Fig. 11l). On its underside, the control element 161 is preferably cross-shaped and has on each arm of the cross two switch actuating pins 166, 167; 168, 169; 170, 171; 172, 173. On

tilting or central depression of the control element 161, two switches, such as the switches 174, 175; 176, 177; 178, 179; 180, 181, will be activated at a time by the said pins. The control element 161 is movable along two guide bars 182, 183, and the control element is depressible against the action of a centrally located spring 184. The said switches, as generally indicated by the reference numeral 165 in Fig. 11f, are preferably made of a contact foil construction, although this should by no means be regarded as limiting for the invention.

Figs. 11g, 11h, 11i and 11j show how the control element 161 can be tilted to actuate the respective switches two at a time. The control element 161, which in reality forms the slide itself, is thus movable along, depressible and tiltable in four directions relative to the said two guide bars 182, 183, and it will be seen that these guide bars extend through oval holes 182, 183, in the slide and are anchored to the device housing.

The solution shown in Figs. 11k-11m is in reality a modification of the solution shown in Figs. 11a-11j. In this case, the device has a control element 185 for controlling user functions and where this control element has a plurality of pressure points for selectively actuating switches 186-193 located on the operating device housing 194 or on a base member 195 in the housing on tilting or depression of the control element. On its underside, the control element is cross-shaped, as indicated in Fig. 11m, and has on each arm of the cross two switch actuating buttons, as for example the buttons 196, 187, 198 and 199. The switch actuating studs on the two other arms of the cross cannot be seen in Fig. 11k. On tilting or central depression of the control element, two switches at a time are always activated by means of respective two of said pins.

In Fig. 11k it can be seen clearly that the control element 185 is a part of a stepwise rotatable control button 200. A means, e.g., of the contact field type with sliding contacts, is also provided for detecting the rotation of the operating button. The said switches which are on the operating device housing or on said base member 195 can optionally be made of a contact foil construction.

The control element, like the control element shown in Figs. 11a-11j, is depressible and tiltable in four directions relative to two guide bars 201, 202 which extend through oval holes 201', 202' in the control element and are mounted in the device housing. The operating button 200 is rotatable about a pin 203 and the control element itself 198 is depressible against the action of a spring 204.

Another operating device will now be described in connection with Figs. 12a-12d and with a modification as shown in connection with Fig. 12e. In this embodiment, the device has a control element 205 which is mounted on a slide 206, which slide is made to move stepwise along a first axial direction by a spring-loaded pin structure 207 that cooperates with a corrugated inner wall 208 of the operating device housing. The control element 205 is provided with a plurality of pressure points for selectively actuating switches 209-212 and 213 located on the slide on tilting or depression of the control element. Central depression of the control element 205 is designed to activate the switch 213 located centrally on the upper side of the slide. The control element 205 is also operatively connected to a cross-armed arm structure 214 in order on selective tilting of the control element to actuate the non-central switches 209-212. However, it is important to note that depression of the control element 205 at a pressure point on one side relative to the centre of the control element effects activation of one switch of the said switches 209-212 located on the underside of the slide, as is shown clearly in Fig. 12b, the switch in such a case being on the diametrically opposite side of said centre.

Electrical connection with the switches 209-213 on the slide is provided by busbars mounted on the device housing 215 and facing the underside of the slide. There are sliding contacts 217 on the slide and the stepwise position of the slide is determined by means of a busbar 218 and the stepwise contact points 219 which cooperate with respective sliding contacts 217 on the slide. A circuit board 220 may advantageously be provided in the slide for a common connection of the respective switches 209-213.

Figs. 12c and 12d show in a simplified manner what happens when the operating device enters into operation and how on a central depression the switch 213 is activated because the spring in the switch 213 collapses. If the control element 205 is depressed at an end part, as indicated in Fig. 12d, the switch 210 will be activated.

The solution shown in Fig. 12e differs from that which can be seen from Figs. 12a-12d. Here too, there is a control element 221 that is provided with a plurality of pressure points for selectively activating switches such as switches 209-213 shown in Fig. 12a and Fig. 12b on tilting or depression of the control element. Instead of having the switches located on a slide 206, the switches, as for example the switches indicated by the reference numerals 222, 224 and 225, are located on an engagement block intended for an arm structure 226 in the device housing. A central depression of the control element 221 is designed to activate the centrally located switch 222 on the upper side of the block 223. The control element 221 is operatively connected to the cross-shaped

arm structure 226 in order on selective tilting of the control element to actuate the non-centrally located switches, such as the switches 224 and 225. Downward tilting of the control element at a pressure point on one side relative to the centre of the control element is designed to activate a switch located on the underside of the block on the diametrically opposite side of said centre. When the control element 221 is then depressed as indicated by the arrow, the switch 225, because of the arm structure 226, will be actuated to form contact. Similarly, the switch 224 will be activated if the control element 221 is depressed on a diametrically opposite side of the control element.

As indicated in Fig. 12e, the control element can include a stepwise rotatable operating button 227, which is rotatable about a support 228. A means is provided for detecting the rotation of the operating button, e.g., through the use of contact points and sliding contacts, as indicated by the reference numerals 229 and 230.

Fig. 13 shows an operating device where the control element 231 is mounted on a slide 232 that is stepwise movable along a first axial direction by using spring-loaded pins 233, 234 which cooperate with a corrugated or toothed inside 233', 234' of the operating device housing 235. The control element 231 has a plurality of pressure points for selectively actuating switches 236-240 located on the slide on tilting or depression of the control element. The control element 231 is connected to a cruciform arm structure 241 which on selective tilting of the control element 231 actuates the non-centrally located switches 236-239, whether these are arranged as shown in Fig. 13e or as shown in Fig. 13f. Central depression of the control element is designed to activate the switch 240 located centrally on the slide, an actuating pin 242 that is connected to the operating button 231' of the control element sliding through a central hole 241' in the arm structure. Electrical connection with the switches 236-240 on the slide 232 is provided by means of busbars 243 arranged on the device housing 235 and facing the underside of the slide, and corresponding sliding contacts, generally indicated by the reference numeral 244, on the underside of the slide. The stepwise position of the slide 232 is determined by means of one of said busbars, indicated by the reference numeral 245, and contact points 246 in stepwise arrangement on said housing and which cooperate with sliding contacts 247 on the slide.

Yet another operating device can be seen from that shown in Figs. 14a-14d. In these figures there is a control element 248 where the control element with its operating button is stepwise rotatable about an axis and has a plurality of pressure points which indicate tilt or depression points for the control element to selectively actuate switches

249-253 that are located on a base member 254 in the device housing 255. The control element 248 consists of said operating button 248' and also includes a cross-shaped arm structure 256 for selectively actuating the non-centrally located switches 249-252 on selective tilting of the control element operating button 248'. A central depression of the operating button 248' will activate the switch 253 located centrally on the base member 254. The arm structure 256 is supported by a spring means 257 which is anchored to the base member 254. However, it should be noted that the arm structure 256 is not rotatable together with the operating button 248', and thus the turning of the operating button will be detectable by a sliding contact and contact point device 258 in connection with the underside of the operating button and the upper side of the arm structure 256. Electrical connection between the base part 254 and the said sliding contacts or contact points can be provided by means of wiring 259 arranged on the spring means 257.

Another operating device according to the invention can be seen from that shown in Figs. 15a-15c. In these figures there is a first control element 260 which is in the form of an annular body that is stepwise rotatable about a second, non-rotatable control element 261. The first control element 260 is provided with a plurality of pressure points so that on depression of a selective one thereof a respective switch in a first set of switches 262-265 arranged on a base member 266 in the device housing 267 is actuated. The second control element 261 is also provided with a plurality of pressure points, in order on depression or tilting at a selective one thereof to actuate a switch in a second set of switches 268-272 arranged on said base member 266. On its underside, the second control element 261 comprises a plurality of switch actuating pins, of which three, indicated by the reference numerals 271', 272' and 269' are shown in Fig. 15b. These switch actuating pins 268'-271' will, on selective tilting of the control element 261, actuate the respective non-centrally located ones of the switches 268-271, whilst central depression of the control element 261 will cause activation of the switch 272. The second control element 261 is supported by a spring means 273 which is anchored to the base member 266. Rotation of the first control element 260 can be detected by means of a sliding contact and contact point device 274 in cooperation between the underside of the first control element 260 and an opposite portion 267' on the device housing.

In the embodiment illustrated in Figs. 16a-16b, there is a control element 275 that is stepwise rotatable about an axis and where the control element operating button 275' is provided with a plurality of pressure points for selectively actuating switches 276-289

arranged on a base member 281 in the device housing 282 on tilting and depression of the control element. The control element 275 is operatively connected to a cruciform arm structure 283 which has switch actuating pins 284, 285, 286, 287, or optionally an annular structure having a plurality of switch actuating pins, so that on selective tilting of the control element one of said switches 276-279 which are not centrally located can be actuated.

A central depression of the control element operating button 275' will activate the centrally located switch 280, a switch actuating pin 288 being connected to the operating button 275' and sliding through a central hole 283' in the arm structure 283. The turning of the operating button 275' is detectable by means of a sliding contact and contact point device 289 in connection with the underside of the operating button 275' and an opposite portion on the device housing 282 or optionally on the base part. The operating button 275' will, with the aid of a spring means 290, form spring engagement with an upper neck portion 283' on the arm structure or on a shoulder part of said annular structure. In the illustrated embodiment, the neck portion 283' has a corrugated circumference in order with the aid of the spring means 290 to cause stepwise rotation of the operating button.

Figs. 16e-16i show how a sliding contact device 291 could form functional cooperation with contact point device 292 on a base member 293. As shown in the exploded view in Fig. 16e, the operating button 275' could be given a stepwise movement by means of a toothed wheel 294 and spring arms 295 when this unit is mounted on a support 296. A back-up ring 297 is supported on the base part 293 and when tilted will actuate the switches 298, 299, 300 and 301. As will be seen from Figs. 16f, g and i, this variant of the switch structure shown and described in connection with Figs. 16a-16d could be compacted, i.e., given a smaller axial extent than would otherwise have been possible.

It is important to be able to optimise the dimensions of the control element relative to the steps through which this can be moved, and when the control element is a stepwise rotatable disc or operating button, where the disc has a diameter d in millimetres, and where the number of steps the disc can be turned is n, there is provided according to the invention a constant $k \in [d/n)]$, wherein k = 1.7 - 2.4 mm /number of steps. This is shown in more detail in Fig. 16c, but it will be understood that this will apply to all control elements made in the form of an operating button.

Other aspects of the present invention will now be described with reference to Figs. 17a-17o and Figs. 36a-36f.

Fig. 17a shows an operating device with a roller-shaped control element 302 which is stepwise rotatable about a shaft and provided with a plurality of pressure points for selectively actuating switches arranged on a base member 303 on tilting or central depression of the control element. In the illustrated example, the stepwise rotation can be provided by a toothed wheel 304 which a spring 305 is arranged to turn.

The control element 302 is rotatably supported about a shaft 306 in a cradle 307 which is supported by three spring-equipped switches 308, 309 and 310. One of the switches, such as the switch 309, will normally be on one side of the shaft 306, as can be seen from Fig. 17d, and the two other switches 308 and 310 are on the opposite side of the shaft 306. A central depression of the control element 302 will activate the centrally located switch 309. On depression at one end or the other of the control element, the cradle will tilt and actuate either the switch 308 or the switch 310. In the illustrated embodiment, rotation of the control element 302 will be detectable by a sliding contact and contact point device 311 in association with an end member of the cradle and an end portion of the control element. In this connection, reference is made in particular to Fig. 17b. As indicated in Fig. 17e, the stepwise movement of the control element 302 is provided by means of two spring-loaded pins 312, 312' which bear against a polygonal inner flange 302' on the control element 302. Further details of the sliding contacts and the contact point device can be seen from Figs. 17e and 17j respectively, indicated by the reference numerals 311' and 311" respectively. On studying Fig. 17, it will be understood that the switches 308-310 are selectively activatable by depressing or tilting the control element, the underside of the cradle 307 actuating the switch in question. The shaft 306 in the illustrated embodiment in Figs. 17b-17j is mounted in elongate holes 313', 314' in posts 313, 314 which extend up from the base part 303 or in the device housing. Such posts are not shown in Fig. 17a, as the cradle in the example illustrated in that figure is connected to the base part 303, for instance via a flexible connection 315. As indicated in Fig. 17h, the control element will be made movable along the shaft 306 in order to activate an additional switch function. This additional switch function can, e.g., be provided by the sliding contacts 311' loosing contact with the contact point device 311".

As shown in Fig. 17k and Fig. 17l, and also in Fig. 17a, the control element 302 is preferably curved inwards towards the shaft along a substantial part of the length of the

control element 302. As indicated in Fig.17l, the inward curve will have a radius of curvature that is equal to or greater than the length of the control element.

In one particular embodiment, as shown in Figs. 17m-17o, at least one of the switches, for example, can be made of a double switch construction, as indicated by the reference numerals 316, 316'. Here, two superimposed switch elements are shown, where these are activated by different activation pressure. Thus, it will be obvious that the switch 316 is activated by a smaller activation pressure than the switch 316'. In this way extended functionality can be obtained in a structure such as that shown in connection with Figs. 17a-17l.

Fig. 36 shows a variant of the solution shown in Fig. 17. Here too, there is a control element 302, a base part 303, switches 308, 309 and 310. The shaft 306 which runs through a longitudinal hole 302' in the control element 302 is supported in elongate holes in end members 316, 317. The control element 302 is rotatably supported relative to a cradle 318 and the stepwise movement is provided in that the control element 302 has a toothed or corrugated flange portion 302" which can engage with a spring-loaded ball 319. The elongate holes in the end members 316, 317 are indicated by the reference numerals 316', 317'.

The solution shown in Fig. 36 also has a variant of the mode of detection that is related to finding the rotational position of the control element 302, and this is provided by a solution where a conducting field or magnetic field 320 is arranged in a stepwise isolated pattern 320' close to the shaft 306. A reading sector 321 is provided on the cradle 318, but this reading sector will usually not cover more than about half of the circumference of the conducting field or magnetic field 320. Thus, the cradle 318 does not cover the upper part of the portion 320. However, this portion is however covered by a cover 322 which is placed on top of the end members 316, 317. Pins 323, 324 projecting down from the cradle 318 will on direct depression on the centre of the control element 302 engage with holes 323', 324' in the base part 303. However, on tilting or depression of an end portion of the control element 302, the pins 323, 324 will be turned so much that they will not engage with the holes 323', 324'. This ensures that there is no form of erroneous detection. In Fig. 36e a braking device 325 is provided. On depression of the control element 302, friction between the control element and the device 325 is obtained, thereby preventing or at least braking rotation.

In connection with that shown and described in connection with Fig. 17 and Fig. 36, reference will now be made to Fig. 18.

In Fig. 18a and Fig. 18b it will be seen that on an end portion of the control element, also indicated by the reference numeral 302 in these figures, there is a ring of n holes 326 which stepwise on rotation of the control element 302 engage with a spring-loaded pin 327. In this connection, reference is also made to Fig. 17g. In Figs. 18a, 18c and 18d, in addition to the control element 302, there is also a second and a third control element indicated by the reference numerals 328 and 329. These control elements are connected via hinges 328', 329' to a respective long side of the cradle 307. A spring-loaded switch 330, respectively 331, is positioned between the base member 303 and the underside of said second and third control element for effecting on depression thereof a supplementary switch function.

It is important to be able to optimise the dimensions of the control element in relation to the steps through which it can be moved, and when the control element is a stepwise rotatable roller or drum which has a largest diameter d in millimetres, and where the number of steps the drum can be turned is n, there is according to the invention a constant $k \in [d/n)]$, wherein $k = 1.5 - 2.0$ mm/number of steps. This is shown in more detail in Fig. 18c, but it will be understood that this will apply to all control elements made in the form of a roller or drum.

Figs. 19a-19d show a variant of the solution in Fig. 18 that has just been described. Here it will be seen that the second and third control elements, respectively indicated by the reference numerals 332 and 333, are made in the form of a cradle in which an operating roller 334, respectively 335, is rotatably supported about a shaft 336, respectively 337. The shafts 336 and 337 are arranged transverse to the shaft 306 of the first control element 302. The respective hinge connections are indicated by the reference numerals 338 and 339. The additional switches actuated by the cradles 332 and 333 are, like those shown and described in connection with Fig. 18, indicated by the reference numerals 330 and 331.

The more structural design is shown in further detail in Figs. 19c and 19d. A further variant of that shown and described in connection with especially Figs. 17 and 18 can be seen now from Figs. 20a-20d. This figures also show a ring-shaped control element 340 which is arranged to have stepwise rotation about the roller-shaped control element 302 and which is spring-supported by at least three, preferably four, spring-equipped

switches 341-344. Depression of the ring-shaped control element at depression points that are selected causes activation of an adjacent switch of the switches 341-344. The rest of the details in connection with the control element 302 can be seen from the description for Fig. 17. In the embodiment shown in Fig. 20b, the control elements or the rollers 302, 334 and 335 have a natural reference to that shown and disclosed in connection with Fig. 18. In this case, the ring-shaped control element 340 is arranged to have stepwise rotation about the roller-shaped control element 302 and the second and third control elements 334, 335 articulated to its cradle 307. The ring-shaped control element, as shown and described in connection with Figs. 20a, 20b, is spring-supported by at least three, preferably four, spring-equipped switches. Depression of the ring-shaped control element 340 at selected pressure points causes activation of an adjacent switch of the switches 341-344.

The operating device shown in Figs. 21a-21c has a control element 345 with an operating button 345'. The control element 345 is stepwise rotatable in relation to the device housing 346, and the operating button of the control element is provided with a plurality of pressure points in order on depression at a selective one thereof to actuate a switch in a set of switches located on the base member 347 in the device housing. In addition, the control element with its operating button 345' is movable sideways so as to be able to activate a kick switch or toggle switch function. This is shown in particular in Fig. 21b. On its underside, the base part 347 is provided with a plurality of said kick switches or toggle switches, of which two are indicated by the reference numerals 348, 349. The operating button 345' of the control element is rotatably supported about a pivot pin 350 that is supported via a central hole 351 in the base member 347 and at its end is tiltable about a journal 352 in the housing. A spider or a round disc 353 is fixed at said end of the pivot pin 350. When the button is pushed sideways in one direction, as shown in Fig. 21b, the pivot pin 350 is made to tilt about the journal 352 and thus urge the spider or the disc 353 to activate the switch 349 on the underside of the base member, this switch being located on one side of the pivot pin 350 which is opposite the direction of movement of the button 345'. However, if the operating button 345' is depressed at one of said pressure points, one of a plurality of switches, of which just two are shown in Fig. 21c, namely the switches 354, 355, will be activated. In Fig. 21c it will be seen that the switch 354 located on the upper side of the base part is activated.

The rotation of the operating button 345' will be detectable by a sliding contact and contact point device 356 in connection with the underside of the operating button and an opposite portion on the base part 347. Fig. 22 must to some extent be considered in

connection with what was shown and described in connection with Figs. 13 and 17. Fig. 22a shows that the control element is made by using at least two rollers 357,358 over which an endless belt 359 runs. Fig. 22b shows a cross-section through a roller, e.g., the roller 358 which is superjacent a base part 360. Fig. 22c and Fig. 22d indicate typical pressure points which may conceivably be used in connection with the depression of the belt and thus the rollers, in order to actuate switches in connection with the construction. A more detailed description of this can be seen from Fig. 22e. Here, it will be seen that the control element consisting of the rollers 357, 358 and the belt 359 is supported in a cradle 361. Actuation of the belt 359 causes rotation of the rollers 357, 358, and a detector 362 will be able to detect the stepwise passing of holes or markings 363 on one of the rollers when the belt is moved stepwise. To secure the stepwise movement, there may, for example, be provided a spring mechanism 364 which rides in depressions 365 in a stepwise arrangement when the belt is moved. A stepwise movement and rotation are possible as shown in connection with Fig. 17 and Fig. 36.

The control element, which consists of the rollers 357, 358, the belt 359 and the cradle 361 is also operatively connected to a cross-armed arm structure 366 in order on selective tilting of the unit 357-359 and 361 to actuate the non-centrally located switches, i.e., the switches 367-370. As mentioned, central depression of the control element, i.e., including the cradle 361, will activate a centrally located switch 371, an actuating pin 372 being connected to the control element via the cradle 361 slidable through a central hole 366' in the arm structure.

Fig. 23 shows arrangements of a particular operating button which constitutes a control element and which preferably is designed to be slidably movable on an operating device. In the illustrated embodiments, the operating button has a substantially concave finger rest portion and in the embodiment shown in Figs. 23 and 24, these finger friction members or engaging members may be studs 373. Alternatively, as shown in Fig. 24, the concave portion can be made having a corrugated structure consisting of a plurality of pyramid-shaped studs or depressions 374, as indicated in Fig. 24. In yet another alternative, as shown in Fig. 26, the concave portion may be made having a plurality of concentric rings 375. As shown in Fig. 27, it is also possible that the operating button could have a surface made having four distinct finger engaging or friction contact surfaces 376-379 to be able to obtain a good tilting motion of the control element via its operating button, here indicated generally by the reference numeral 380.

In yet another alternative as shown in Fig. 28, there are crescent-shaped protrusions 381 and studs 382 in the concave portion. If the operating buttons are made as shown in Figs. 25-28, advantageous engaging portions for cooperation with the user's finger can be obtained.

Figs. 29-31 indicate an operating device, especially for controlling user functions in electronic user equipment in interaction with a display screen (not shown). The device as shown in Fig. 29 has a control element 383 which can be provided with a plurality of pressure points for actuating a switch in a set of switches on depression or tilting at a selective one of the pressure points. However, for clarity, these switches are not shown in this simplified figure, but will be immediately conceivable from what has been shown and described earlier in the present description and with reference to the drawings. It will be desirable, especially on central depression, but also on the tilting of a control element of this kind, whether it has a horizontal shaft as shown in Figs. 29 and 30 or a vertical shaft as shown in Fig. 31, to be able to lock the control element against rotation during activation of a switch. As shown in Figs. 29a and 29b, depression will result in a wedging action between the control element 383 and a wedge-shaped means 384. In the solution shown in Fig. 31, the control element is indicated by the reference numeral 385 and the wedging means is indicated by the reference numeral 386. Both on central depression of the control element 385 and on depression close to its periphery, it will be possible to obtain a wedging action, and thus a locking of the control element 385 relative to the operating device housing 387, so as to cause a definite activation of a relevant switch. Thus, in connection with the embodiments in Figs. 29 and 31, a clamping wedging action is employed. In the solution shown in Fig. 30, however, a plurality of cut-outs 388 are provided on the control element for causing engagement between the cut-outs 388 and a locking pin 390 on the housing 391 when the control element 389 is depressed.

Fig. 32 and Fig. 33 show two alternative solutions based respectively on the solution shown in Fig. 30 and that shown in Figs. 29 and 31. In Fig. 32 it will be seen that pins 393, 394 are provided in connection with the operating button 392 which are designed to form a releasable engagement with cut-outs 393', 394' in the operating device housing 395. However, it will be understood that instead of engaging with said housing, the control element, here symbolised by the operating button 392, will also be able to engage with a cradle or a support if the control element has a design other than that shown here. Furthermore, Fig. 33 shows that the operating button 396 has a rounded or bevelled portion 396' which on depression of the control button is designed to form

clamping engagement with a bevelled portion 397 of the device housing 398. However, said housing 398 can also be regarded as being related to, for example, a cradle or a support that is an integral part of an operating device if, for example, the control element has another design, e.g., a roller form. In Fig. 34 a further variant of the solution just described in Fig. 32 can be seen. Here, it will be seen that a large number of pins 400 are arranged on the housing 399 for locking the control element operating button 410 against rotation by one of said pins 400 engaging with a cut-out or hole 402 on the underside of the operating button 401. The construction shown in Fig. 34 is also related to that shown and described in connection with Figs. 16a-16d and a further explanation is therefore not required.

Fig. 35 shows an operating device for a control element 403. The control element is arranged on a cradle 404, and the control element 403 is provided with a plurality of pressure points for selectively actuating switches located on the operating device housing or on a base member thereof on tilting and depression of the control element. The control element is a roller that is rotatably mounted on a shaft 405 in the cradle 404, and rotation of the roller is detectable by means of a sliding contact and contact point device 406 in connection with an end member of the cradle and an end portion of the control element. The switches, as indicated by the reference numerals 407, 408, 409 and 410, are preferably made of a contact foil construction, although this should by no means be regarded as limiting for the invention. The cradle is centrally depressible, but also tiltable relative to two guide bars 411, 412 which extend through oval holes 411', 412' in the cradle and are mounted in the device housing or in member 413 which projects up from a base part 414 of the operating device.

The said switches 407-410 are selectively activatable by depressing or tilting the control element 403, whereby the underside of the cradle actuates relevant switches. However, it is important to note that either on central depression or on sideways tilting of the control element and thus the cradle, two switches are always activated at a time. Thus, either the switches 407, 408 will be activated together, the switches 408 and 409 will be activated together on central depression, or the switches 409 and 410 will be activated on sideways tilting.

Fig. 37 and Fig. 38 have been included to illustrate aspects of the present invention associated with the concept of "force feedback". The solution shown in Fig. 37 in particular can be envisaged in connection with the solution shown in Fig. 7. The idea here is to be able to supply electricity to generate magnetism and bring about voltage

between the static part 415 and the rotatable part 416. In this way it will be possible to program a roller detection, and make it possible to stop or brake the rotation electrically by controlled magnetism, e.g., when moving through a menu, but then moving towards the end or the start of such a menu. The magnetic elements used are merely indicated by Fig. 37 by the reference numeral 417. The power-supplied elements for generating magnetism are indicated by the reference numeral 418 in Fig. 37. Similar technology could also be used for a control element 419 which has a vertical shaft as shown in Fig. 38.

Figs. 39-45 show the principle of a variant of the operating devices described thus far, especially in connection with a device where the control element is rotatable. However, it is also possible to envisage the solution described in Figs. 39-45 in connection with a slide-based operating device.

In the solution shown in Figs. 39 and 40, it is assumed that the control element, indicated by the reference numeral 420, cooperates with or is an integral part of a so-called step motor. A step motor of this kind may be connected to equipment for performing operations selected from the group: controlling the number of steps, controlling the space between steps, controlling the force the user needs to apply, braking or stopping movement of the control element 420, causing a back or return movement, or stimulating or oscillating (small reciprocating motions) and detecting movement and direction of movement. As shown in Figs. 39 and 40, it is intended that the step motor casing should form the control element 420, whilst the step motor rotor 421 and rotor shaft 421' are maintained stationary. However, it is conceivable that the step motor rotor shaft 421' can be connected to a control element and that the step motor casing is arranged to be stationary. This is shown in more detail in Fig. 45 where the control element with an operating button is indicated by the reference numeral 422, the step motor shaft is indicated by the reference numeral 423, the step motor rotor is indicated by the reference numeral 424, and the stator of the motor is indicated by 425. A rotation detector 426, 426' can be mounted in connection with the step motor to detect the mutual rotation between the motor casing and its shaft, as for instance indicated in Fig. 39.

Use of a step motor in connection with a roller switch is a new concept. The idea here is to be able to control, i.e., actuate during use, rotation of the switch by coding a microprocessor which communicates with the programs in a functional apparatus. One object is, for instance by means a combination of magnets and/or electromagnets, to

provide fields of force which simulate steps, instead of springs and grooves. By using a step motor it is possible to make movements of the rotation of the control element (the roller) which become interactive with presentations on a display.

This means that if the user has a menu through which he scrolls, the roller can be caused to brake or stop at the end of the menu list. In Fig. 40, the shaft and the rotor 421 must be fixedly mounted, and the roller will be attached almost like a coating on the outside of the motor stator 420, which will now be able to rotate.

Figs. 41a, 41b, 42a and 42b show a principle where there are fields which can be charged (optionally are fixed, magnetic) along the shaft of the roller and inside the roller. In Fig. 41, the reference numeral 427 denotes a rotor shaft, 428 a roller (the stator frame of the motor), 429 an active winding and 430 a winding. In Fig. 42, the reference numeral 431 indicates a magnetically charged shaft, 423 a roller (the stator frame of the motor) and 433 a winding. In effect, it is shown how a step motor can be used in this connection, and the mode of operation is in other respects known to the skilled person. Fig. 41 shows windings arranged on the inside of the roller, i.e., on the movable part of the switch. On rotation, power is supplied to all or a selected number of the windings to create steps. By further supplying power, it is possible to brake or stop, or optionally reverse the roller, for example, in connection with said menu scrolling. In step motor technology it is also possible to program in different step variants. In one situation, it may be desirable to have many steps per rotation, e.g., 18, whilst in another function 9 is more appropriate.

The use of a step motor /flux will make it possible to employ fixed magnets in cooperation with electrically loaded windings, or to only employ windings so that it is possible to control all the steps. Fig. 41 shows a solution where only windings are used. In this case, fixed mechanical steps will have to be used if power is not supplied to the windings at all times.

Fig. 42 shows an example of windings which cooperate with fixed magnets. In this case, it is possible to avoid mechanical steps, but the possibility of removing or changing the steps will then be limited.

Fig. 43 and Fig. 44 show variants of Fig. 41 and Fig. 42. In Fig. 43, the reference numeral 434 denotes the fixedly mounted rotor of the motor, 435 is a roller which forms the control element and which consists of the motor stator and is in this case designed to

rotate because the stator is held still, and in Fig. 44 the reference 437 indicates a rotor is that is held still, 438 is the stator frame which in this case is to rotate, and 439 indicates a metal piece that is not charged, but is actuated by energised windings which pass by. When there is a switch that is to be rotated, it will be appropriate that the parts which rotate are non-current carrying, i.e., that in this case they do not have windings. Arranged inside the roller (stator frame) or a rotatable disc member are magnets or metal that is attracted to/repelled from the windings.

As regards detection of rotation and direction, this can conceivably also be done by measuring the force and the direction of the magnetic fields which will change when this technology is used. There are also possibilities for combinations of the principles described, but these will not be discussed in more detail here.

When using the suggested flux principles, it will normally not be necessary to install extra technical equipment to detect movements, its steps and direction. The direction of the current will at all times be known, and the fields of force are measurable, which means that the direction of movement of the operating device can thus be deduced. Alternation of the fields of force will indicate the number of steps over which such a device moves.

Use of step motor technology, especially with sufficient miniaturisation, will be applicable in a number of operating devices of the rotation and sliding type. Examples in this connection are, for instance, variants of the solutions that can be seen in Figs. 7 and 8, and Fig. 37. Thus, it is conceivable that the solution could be applied to roller switches, rotary switches and sliding switches.

A rotatable multifunction roller switch with built-in electromotor or step motor and three presses, or pressing and two-way tilting function is shown in Figs. 46a and 46b. The operating device of the switch 501 is mounted in a carriage or frame 503 which rests directly on three springs 505-505". The reference numeral 507 indicates an elevation which prevents the collapse of more than one spring at a time. The operating device 501 of the switch forms an outer part of the motor together with the coil 502. The inner magnetic part 504 is then fixed. The coil is supplied with power via brushes 508 in a known way. At the other end of the rotating switch part, the rotation and its direction be detected as indicated by the reference numeral 509. This can be done by using a selection of the techniques that will be described in connection with Fig. 48. Depression or tilting of the operating device 501 is detected in that springs 505 mounted

on an underlying circuit board with contact points, collapse when downward force is applied to the switch element. The point of an electromotor inside a switch of this kind is to be able, during use, to give a counterforce which the user will feel on his finger, illustrated in Fig. 46c. A motor of this kind is a common commercial product, but according to the invention it is used in an entirely different manner than the intended normal use of the motor. The motor may, e.g., be of Maxon type from Interlectric AG, CH-6072 Sachseln, Switzerland, although other types of motors can be used.

Fig. 47 shows a roller switch with a motor mounted inside the operating element. The operating element is mounted in a frame or carriage 503 and is rotatable relative thereto.

The frame may be fixed as shown in Fig. 47a, or mounted as shown in Fig. 47b where the switch is tiltable and depressible about a shaft 510. As shown in Fig. 47d, the frame consists of a base part 519 and two side members 519 and 519', and an intermediate connecting piece 517. The frame as shown in Figure 47b has an element 511 secured therein which is movable up and down, but not turnable to prevent rotation about the shaft 510. The coil part 502 is in fixed connection with the operating element 501. However, between the coil and the operating element is a metal sleeve 520 of iron to provide magnetic return of the magnetic field. This sleeve will thus "compress" the field of force. The coil is supplied with power via brushes 508 which are connected to connector terminals 512, see Fig. 47c. The coil 502 is supported at one end by a bearing 515 and at the other end by a bearing 514 which lies between the coil and the magnetic part 504. The rotation in this figure is read by using Hall sensors which sense change in polarity. A ring 516, see Fig. 47a and Fig. 47d, consists of magnets having varying polarity. Two Hall sensors 518 lie and sense the rotation and its direction. Connection points are passed out at terminals 513, see Fig. 47c. The stepwise sensing during use is generated by supplying alternating current to the coil 502 which is controlled by the readings from the Hall sensors 518.

Figures 47f-47t show possible pressing functions that the switch can have, i.e., none, two or three. In use, this can be combined with external pressure-operated switches in interaction with systems that are commented on further in connection with Figure 64. This form of cooperation between a roller with force feedback and subjacent or adjacent switches is also explained in connection with Figs. 1-45.

Figure 48 shows other alternatives for detection of rotation than those explained in connection with Fig. 47. Rotation can be detected by using resistors 521, 522 having

different values as illustrated in Fig. 48a, and where resistor overlapping is provided, and by using sliding contacts 521', 522'. Detection by using sliding contacts 523 against contact points 523' is shown in Fig. 48b. CD-ROM 524 or a floppy disc 525 technology can also be used together with optical and magnetic detectors 524', 525', respectively, as illustrated by Fig. 48a and Fig. 48d respectively. Pure optical reading by using a light emitter and light receiver 526 in connection with reflection from a disc 526' as shown in Fig. 48e or by using light emitter 527 and light receiver 527' for detection of light through holes 527" in a rotatable disc 527"' as shown in Fig. 48f. The technique shown in Fig. 48 is known to anyone of ordinary skill in the art and will therefore not be described in more detail.

Furthermore, it will be shown how rotary switches can be actuated by an electromotor, or step motor where this is not mounted inside the control element. Fig. 49 shows how an operating element or control element 530 can be connected to a gearwheel 531 via an internal gear rim 532. Figs. 49a-49d show how the gearwheel 531 meshes with the teeth 532 on the inside of the operating element 530. If a depression function is present, as in the case of Fig. 49d, shown by Figs. 49b-49c, the gearwheel 531 will be able to disengage from the gear rim 531. The advantage here is that the motor 533 and the connection 534 to the gearwheel 531 may be fixed.

Figs. 50a and 50b show how force can be supplied through a mechanical connection 535, e.g., a Bowden cable connection, a wire connection, a connecting member of flexible material or structure. The connection may also be via an articulated shaft, e.g., double universal joint connection 536.

Figs. 51a and 51g show how it is possible to transmit force via a gearwheel 538 mounted in the extension of the shaft of the operating element 540. Mounted on the motor shaft is a gearwheel 542 which meshes with the gearwheel 538. On depression or tilting of the switch, the gearwheel 542 will spring towards the motor shaft 537 shown with the aid of a spring 544.

Figures 52a-52b show an embodiment for force transmission via a belt 546. The belt may be smooth or toothed. The belt will be so flexible that there will be no problems in connection with the depression of the operating element 540, as indicated by the arrow 541.

Figures 53a-53c shows a five pressure point or pressure and four-way rotary switch as previously shown in connection with some of preceding Figures 1-45. Here, the switch is shown with force transmission via gear wheel 549 and gear rim 550" on the operating element or control element 550, see Figs. 53a and 53b, and alternatively with a belt transmission as shown in Fig. 53c. In both cases, the motor 547 shaft 548 is parallel to the axis of rotation 550' of the switch. This permits transmission of force directly on the switch operating element 550 which then will have a partly toothed periphery 550", i.e., said gear rim.

Figures 54a-54c shows a four pressure point or tiltable rotary switch where the operating element 552 is mounted directly on the shaft of the electromotor 554. The connection point 556 on the electromotor is spherical, has engaging teeth and is part of a tiltable, but non-turnable fixing point 558 on the underside of the operating element 552. The figure also shows a ring 560 which when mounted in an apparatus will be joined together with the apparatus housing. The reference numeral 562 represents a disc that is fixedly mounted, but is movable downwards for pressing springs 564 and contacting with contact points 566 on a circuit board 568. Electrical connections to the motor 554 are indicated by the reference numeral 569.

Figure 55 shows a rotary switch with central depression and four-way tilting, or pressure positions axially mounted on a motor 573 for force feedback. The motor shaft 570 here passes through a central spring 572 and contact point or switch in the circuit board and the central depression part or the stem 576. The switch itself is otherwise essentially like the solution described in connection with Fig. 56.

In connection with Figs. 56a-56d, a rotary switch with central depression and four-way tilting or pressure positions will be described. Switch part 580', together with the rotation, tilting and pressing part 582, forms the operating element 580. The operating element or control element is mounted so as to be stepwise rotatable about a frame part 584. A spring 586 is secured to the part 582 and springs against a polygonal peripheral portion or steps 588 on the frame part 584. About the downward projecting portion of the part 582 is a tilting part 592 with four arms, like a spider. This is not actuated by direct depression, but will tilt and collapse switch springs 594 on sideways pressure on the operating element. A shaft part 596 is fixedly connected to the part 582 and is in engagement with sliding spring 598 or a modification 599 thereof. On rotation of the operating element, the spring will run across the circuit board 600 where this has a detection ring 602. The reference numeral 604 is a depression part for central

depression of the operating element for collapsing a spring 606. Four lateral tilt contact points 608 are placed in a separate, but parallel plane in this construction, although they could conceivably be placed in the same plane. Fig. 56c shows a small variant where the central shaft part 596 is mounted so as to be axially movable about the operating element 580. Mounted between the downward projecting part 590 and the shaft part or stem 596 is a spring part 610, for example, an O-ring of an elastically yielding material. This means that on depression the spring and contact points on the circuit board will not be unduly loaded. The actual design of the touch part of the operating element may of course vary, but to obtain an exact feeling of central depression a small peak 580" is formed in the centre. For finger friction during rotation, there is also a ridged pattern 580"' in the periphery.

Fig. 57a shows a rotary switch with central depression and four-way tilting or pressure positions of a slightly different construction than that shown in Fig. 56. An operating element 612 consists of a touch part 612' fastened to a rotary part 614. Fastened to the rotary part 614 is a spring 616 which on rotation of the part 614 gives a stepwise movement about a polygonal portion or steps 620 on a spider or tilting part 618. The part 618 has four feet or small arms 618 which rest on four spring 622 and are held rotatably fixed, but tiltable by a frame part 626. A shaft part immediately below the touch part 612' passes through the rotary part 614, and is axially slidable and rotatable about the parts 626 and 618 and rests on a spring 624. On central depression of the operating element, the spring 624 will collapse. Secured immediately below the part 614 is a spring 630 for detection of the stepwise rotation. This spring, which normally spans across an angle slightly greater than 180°, is in contact with the circuit board 632 and its contact field 634. An O ring 636 is placed between the part 618 and an insulating layer 638. The design of the finger touch part of the operating element is in principle the same as that described for Fig. 56.

Another variant of a rotary switch with central depression and four-way tilting or pressure positions will now be described in connection with Figs. 58a-58d, but this switch has in addition a central position deviation function. A pin 650 through the centre of the structure is in engagement with a central control element 652 which can be moved axially relative to the pin 650 in order on depression to push down a shaft part 654 and cause collapse and contacting of a central switch contact point part 668' on the circuit board which cooperates with a central contact spring 656' On sideways displacement of the element 652, a disc 658 will be made to turn and this will be detected by strain gauges 660 mounted thereon. This forms a starting point for

calculating a deviation in the centre position which can be transmitted to cause a screen pointer to move freely on a display screen. The parts 662 and 664 form a supporting frame for the disc 658 and are fastened beneath the circuit board 666 which contains contact points 668, 668' for the total of five depression points and possible rotation that this switch solution has. The contact points 668 cooperate with respective contact springs 656. It will be noted that the pin 650 extends through a hole in the central one 668' of the switches' contact point parts and similarly through a hole in the contact spring 656. The parts 651, 653, 655, 657, 657', 659 and 661 will now be described. The reference numeral 651 represents a control element which encircles the control element 652. The rotatable control element 651 rotates relative to a fixed element 653 through which the pin 654 extends. The element 653 has a toothed periphery and forms, with the aid of spring 655', spring engagement with pins 655, 655' that are mounted on a supporting disc 657 and mounted there with their respective holes on journals 657', 657". A combined rotation detector and spring 659 is provided and cooperates with contact field 663 on the circuit board 666. A non-rotatable depression element 661 is arranged for actuation of the springs 656 on tilting/depression of the element 651. The reference numeral 665 denotes a sleeve.

The switch solution with rotation of a belt will now be described with reference to Fig. 59. The principle of detection of rotation follows that which has been shown earlier and should by no means be regarded as limiting for the solution. Fig. 59a is an exploded view of the construction which consists of an endless belt 680 that passes around rollers 681 and 682. Detection of rotation takes place at one end of the roller 618 with the aid of a sliding spring 684 which touches contact points on a support 686. The stepwise rotation is generated by a spring 688 which will be in engagement with notches (not shown) in the other end of the roller 681. The rollers are mounted in a support which is formed of a frame 692, side members 694 and 696, and a bridge-like central part 698. The frame 692 is fixedly mounted at a central area 692' to a base plate or a circuit board 702 and rests there on four springs 700, 700', 700" and 700'". On depression of the belt 680 over this orientation, the frame 692 will move and collapse one of the springs down onto the circuit board 702. The frame 692 can move slightly because of flexibility in the cross-shape as shown at 692". A spring switch 704 with contact point is positioned on the bridge 698 for detection of central depression. This is possible because a downward flexible part 706 rests directly on 704. The belt slides over the part 706, but is so flexible that depression will be possible. The part 706 also protects the switch spring 704 from wear or damage when the belt runs over the part 706. The depression points are marked in Fig. 59d by X. If the belt as shown here runs between outer

members 694 and 696 of the frame, sideways tilting could be activated by direct pressure as shown by the broken X, see also the indication 690.

It is natural to envisage a force feedback solution here if a motor 708 is placed inside one of the rollers, for example, the roller 682 in connection with the motor 708. If such a solution is not to result in the belt slipping from the rollers, it may be necessary to make a toothed belt solution such as that indicated in Fig. 61a.

Figs. 60a-60g show another variant of the belt switch described above. Here, there are three spring switches 710-710" on a bridge 712 which is a part of the frame 714 that will detect pressure on the belt at the positions 714-714". On depression at the points 720 and 720', the rollers 716 and 718 cause contact on collapse of respective springs 722 and 722' in that the roller is mounted in one of the shaft ends 724, 724'. Figure 60f shows how a variant where both the rollers in a roller switch are mounted in a fixed frame can have five depression points 728, 728', 728", 728"', 728"" under the belt according to the same principle as described above. Figure 60g indicates possibilities for force feedback (FF) for the belt solution through the use of two motors 726 and 726'. Here, it will be necessary to synchronise the motors either mechanically by bars or toothed belts, see Figs. 61c and 61d, or by using position detection combined with programming.

Figs. 60h-60yy show different alternative, possible, but not exhaustive examples of combinations of multifunction switch of the roller belt type, either without or with one to five switches located on a bridge under the belt, or where such bridged-positioned switches are replaced by or supplemented with switches located outside the multifunction switch, as for instance switches 729, 729' and/or 729", 729"'.

Figures 61a and 61b show a variant of step detection where a roller 730 has teeth 732 or ridges in the roller, and that a contact spring 734 or mechanical arm is provided which with its end forms stepwise releasable engagement with the teeth or ridges. The teeth here will optionally also be able engage with the underside of the belt to synchronise the detection and the stepwise rotation here represented on the roller 731 by stepwise depressions 738 with which, for example, a spring-loaded ball 739 can engage. On the arm or the spring 734 there may be, e.g., piezoelectric elements or strain gauges 733, 735 which can form a part of a measuring circuit to detect the stepwise movements to which the roller and thus the belt are subjected. At the same time, the mechanical movement that takes place for the arm 734 from, e.g., one tooth to the next, gives a

signal of the movement that is audible to the user. Of course, it is quite conceivable that the arm 734 and the teeth 732 are so robust that it will be unnecessary to have the ball 739 in successive engagement with the depressions 731 on the roller.

Synchronisation of the movement of the rollers is also shown in Fig. 61c. Here, the rollers 740, 741 can, e.g., each be rotatable with a common connecting rod 742, or as shown in Fig. 61d, the rollers 743, 744 can have a synchronised movement on toothed engagement with a belt 745 which has a toothed rear side.

Fig. 61e indicates that the roller 746 can have a plurality of magnetic areas 747 extending in an axial direction and spaced apart around the roller to form a corresponding number of magnetic fields, and which on rotation of the roller are detectable by a magnetic field detector 748. It is also conceivable that there is a magneto armature 749 past which the roller is designed to roll, and where resistance will be felt on, e.g., passing away from the magnetic field, whereby the stepwise operation that can be sensed for detection of rotation is indicated.

A solution to a problem relating force feedback (FF) will be described below with support from Figs. 62a and 62b. By using a solution having a motor 750 inside a roller switch 751 without introducing fixed steps on the switch as shown in, for example, Fig. 47, the motor has to be supplied with current to have fixed or noticeable steps. The current can be activated as the user starts to rotate the switch. The switch will nevertheless give the user the feeling that it is loose and almost free-rolling as the user starts by moving it so that it begins to rotate. To avoid this, different methods may be employed to detect that a finger is about to come into contact with the switch. Fig. 62a outlines that a conductive or capacitive technique can be used to effect this detect. When a finger 752 touches the switch control element 753, the conductive or capacitive sensor 753 will send signals via a processor (not shown) which activate the switch before the user has started to rotate it. Steps and detection that are provided by means of the motor 750 will then be activated at once. This solution is of particular importance in connection with a power saving function, as continuous power supply to the motor, even when the multifunction switch is not operated by the user, will increase the power consumption per time unit considerably and be particularly problematic in connection with battery operation of electronic equipment. Fig. 62b shows an alternative solution where optics is used. Light transmitters 754 and receivers 755 can form beams which are broken when the switch 756 is touched. Alternatively, it is conceivable that the receiver 755 is an infrared detector that detects the presence of the

heat of the finger or that an infrared detector registers that the user is approaching the multifunction switch on the electrical equipment. In this case, a light transmitter is not required.

Another problem with a switch that has no fixed mechanical steps will be that when it is not in use it will be slightly "loose", i.e., it can easily rotate in an uncontrolled manner. Fig. 63 shows a principle where the rotary element or the roller 760 has a field 762 against which a piezoelectric element acts and can lock the rotating movement. When voltage polarity of the element is right, the locking or braking effect can be neutralised. Two areas of use are conceivable, one being to lock the switch when it is not in use. The other will to be lock the switch in connection with navigation in a menu which will be described in more detail in connection with Figure 64.

All the solutions presented in this description could be used for the system that will be described in connection with Fig. 64. In addition, reference is made to the Applicant's international patent applications, PCT/NO00/00412 and PCT/NO01/00056 and Norwegian Patent Application NO 2001 4796.

The reference numerals 770-770" refer to alternative multifunction switches, where 770 denotes a roller switch, 770' denotes a tilting switch or a sliding switch, and 770" denotes a disc-shaped rotary switch. These may be exposed to a source of force for force feedback (FF) indicated by the reference numeral 772. Movement of the switch is detected by the element or elements indicated by 774. These signals are processed by processor 776 that is connected to a computer 778 for further processing in interaction with a computer program 780, or directly to the control unit 772 that actuates the switch. Signals pass via the computer (PC) to a screen 782 which interactively shows menu alternatives, functions and results in response to the use of the switch and information to the user about the state of the apparatus 784. Apparatus in this context can be anything from a mobile telephone to a vehicle. Functions are represented by the reference numeral 786 and will be controlled by different forms of activators 788. Functions may be to activate a radio function or a GPS function or to move a mirror or window.

The screen image can vary according to the type of apparatus and function, but cursor 790 will in principle be movable in a Y direction over a sub-field on rotation, and by pressing on the switch the user will be able to activate functions or open sub-menus indicated by the reference numeral 794, either in that these spread out in the x direction

of the main menu together with an accompanying cursor, or that the cursor moves to activate functions that are already spread across the screen. Force feedback (FF) implemented in the switch solutions will help the user to navigate better through menus and use of functions. A menu will always have a beginning and an end. Thus, the switch can be activated so that, if desired, it stops or gives resistance when an end of a menu has been reached, or a set limit for a function has been reached. Navigation in the screen image and use of functions are intended to be carried out using the multifunction switches as taught by the Applicant. Nevertheless, it is possible that a number of depression functions are removed from under the switches and arranged as independent pressure switches at the side of the rotating element. Here, given the teaching of the invention, a person of ordinary skill in the art would see that the same system could be used, but then the user would have to move his finger more and perhaps his eyes too in order to do so, which is not particularly favourable, especially when driving a car.

The Applicant has previously described multifunction switches having a sliding function. Figures 65a and 65b show a sliding switch having five presses or press and four-way tilting function. The pressing and tilting function is the same as described, *inter alia*, in connection with Fig. 56d, but in this case there is another mode of detection.

A carriage 800 is movable over a slide and spacer field 802. Attached to the carriage is a spring 804 which enters into engagement with steps 806 in the switch housing 808. A switch top is mounted to a guide which is connected to a tilting part 814, where the tilting part 814 is made in the shape of a cross. The switch control element 810 has a cover 809, as shown enlarged. However, the element 810 with its cover 809 is depressible, a guide 812 sliding through the tilting part 814. When the switch is pressed in the centre 810', the guide 812 will cause a spring 817 to collapse and a pin 816 which passes through the spring 817 will detect pressure on a circuit board 818 and a contact foil 820. Reference numeral 822 represents a spacer layer. The guide 812, the tilting part 814, collapsible springs 815-815''', 817, spring 824 which spring-retains contact balls 826, 826', are held in place by means of a top member 828. A sliding dust cover 830 is placed over this. The stepwise slidable positions of the switch are detected in that the balls 826 and 826' are pressed down through the contact foil by the spring 824. When the switch is tilted, the cross-shaped tilting part 814 will be pressed by one of the springs 815-815''' and an underlying projection 832 down through the contact foil. This is best seen in Figure 65b. The sliding switch in this embodiment has four steps, but this should not be regarded as limiting for the invention. Depression of the control

element 810 at one of the points 811-811''' will cause collapse of a respective spring 815-815''' , thereby activating a respective contact foil point via the tilting part.

As for rotary switches, it is of course possible to provide force feedback (FF) to a five pressure point sliding switch. Figs. 66a and 66b, and Fig. 66c show an example of how a motor 840 can via a gearwheel 842 mesh with a rack 844 in the carriage 846 and control the carriage in steps or positions along the y axis. Anyone of ordinary skill in the art would be able to see how variations of the motor connection in this system could be made. One example of a variant is shown in Fig. 66c, where a motor 848 drives a belt, band, wire or chain 850 that is passed about a drive sheave or driving wheel 852 and another sheave or wheel 852', and where the belt or the like 850 is fastened to a carriage or slide 854.

In other respects, a force feedback (FF) system will function as described in connection with earlier figures and in connection with Figure 64.

Figure 67 shows the principle of a sliding switch 856 with five presses or pressing and four-way tilting function which has a minimal slide path, but where electromagnetic elements or piezoelectric elements. indicated by 858, 860; 858', 860', optionally with the aid of springs 862; 862' can be controlled by supplying electric pulses thereto for force feedback (FF). Here, it could also be appropriate to provide pulses which can simulate stepwise movement.

Although an operating device having a button-like rotating element has been shown and described, it is conceivable that a similar construction can be used without the presence of rotation, i.e., an operating device with a uniform button-like control element having a central depression point, and in a peripheral portion four depression points or four-way tilting possibilities for selective actuation of a respective operative switch function, where the control element is designed to activate a centrally located switch via a central stem when depressed, and where a spider or arm-provided block is arranged in slidable relation to said stem in order on tilting or depression of the control element in a peripheral portion to tilt for actuation of a respective switch located in a peripheral portion of the operating device.

Provision of an operating device, e.g., as shown in Fig. 65, is also conceivable, but this is not slidable stepwise along a path. Thus, in a solution of this kind there will be an operating device with a control element that is designed on depression and /or tilting to

operate a respective switch function of various switch functions, where the switch functions are provided by contact foil portions on the device housing, arms being connected to the control element operating button in order on activation thereof via the arms and catch springs to actuate a respective contact foil portion via ends of a spider, the control element being designed to be able to selectively operate one of four switch functions. In this solution, an additional, fifth possible switch function is provided, the control element being centrally depressible against the action of a catch spring in order, via a pin that is movable through a block connecting the arms and a hole central through the spider, to actuate a switch function related to a respective contact foil portion.

Fig. 68 must be seen in connection with that shown and described in connection with Figs. 66 and 67. The aim is to obtain the advantages present in a slide switch but at the same time obtain a simpler, more compact construction. Fig. 68 shows a sliding switch 900 which has an operating part 901 that can be moved in two directions, shown by the arrow 903. Reference numeral 901' points to a fixing part for the operating part. The operating part, which has a firm surface, is made to activate five contact points in a way similar to that shown in Figure 65. Activation takes place by pressing and/or tilting at the positions 905-905"" of the surface of the operating part. The tilting part 907 which is in direct contact with the operating part will actuate cup springs 909 which then come into contact with contact points on the circuit board 910. The circuit board is fastened to a carriage 912 which is movable in two directions inside a frame 913. By giving the operating element a sliding movement, the whole switch assembly that provides pressing movement and contacting will be moved, in contrast to what is the case according to Fig. 65 where all contacting is stationary, whilst it is only the mechanics that are moved. The carriage 912 is held in a centre position by the action of springs 918-918' that are placed around two shaft parts 922-922' which pass through the frame and the carriage. In contrast to that shown in Fig. 66, the switch has no fixed stepwise positions. Stepwise positions are simulated by using an electromotor 917 that is in engagement with the carriage via gearwheel 919. The gearwheel is in engagement with a rack 920, which in this case is mounted under the switch assembly. Coupling between motor and switch can also be made as shown in Fig. 66. Anyone of ordinary skill in the art would nevertheless be able to see the variations that are possible here. As illustrated in Fig. 64, the motor will be connected to a computer or smaller circuits that include a processor, computer program and screen which show a graphic user interface. By means of a sliding movement of the switch, it will be possible to move data 790 (see Fig. 64) in a menu one step whilst it will feel like a "genuine" step by the user. The system will thus cause the motor to rotate a small step against the sliding movement

applied. Movement is detected by a sensor 915 that is on one of the long sides of the carriage close to a field 916 on the frame. Here, it is possible, for example, to use the principle of resistance (i.e., use a resistance sensor). The solution allows both registration of the sliding direction of the operating element, the extent of its movement and the speed that the movement is given. This means to say that if a user wishes to scroll slowly through a list of data, little force is applied to the operating element. This gives a small movement that is detected by the sensor 915 which gives the system a message regarding activation of the motor for simulated stepwise movement at a low frequency. When a greater force is exerted on the operating element, a larger movement is detected and the system emits a greater frequency of signals in order to provide faster step simulations. The user will then feel on the switch many small steps in rapid succession. When the list of data is finished, the pulses in the direction the user has exerted force cease. When the element is moved in the opposite direction, the user will again move in the list, but in the other direction, and the pulsating step feeling will be activated. A flexible signal cable (not shown) runs from the circuit board and is connected to a frame 913' and/or the associated equipment and apparatus that the switch is to operate.

Fig. 69 shows a rotary switch with five pressure positions and force feedback. The switch is a variant of that previously taught and must be seen in connection with switches such as those shown in Figs. 53-57. The operating element 924 is connected to an electromotor 926 which supplies frequencies of signals to simulate steps on rotation of the switch. The reference numeral 925 indicates a connecting part. Thus, the switch has no mechanical grooves for stepwise rotation. As described previously, it is possible here to vary the number of steps and force on the steps by varying the frequencies of the signals supplied to the motor. A tilting part 928 has construction similar to that shown in Fig. 57, but in this case it is fixed and mounted upside down. The encircling part 929 moves with a circuit board 930 and operating element 924 on tilting to the four sides for activation of the contacts 932-932'''. Between the circuit board and the tilting part is shown a spacer layer 931 which has holes 931' for the contact springs. Central depression activates contact at contact point 933. Reference numeral 933' indicates a contact spring. Passage of power is effected by means of sliding contacts 934 and 934'.

Figs. 70a, 70b and 70c show a rotary switch with sliding function. Fig. 70c shows a section taken along the line LXXc-LXXc in Fig. 70d. When pressure is applied to the operating element 950, a centre part 951 will activate switch function by means of contact point 952 and spring 953. An intermediate part 954 is fixed in the operating

element and contains a spring 956. In the same way as shown in Fig. 56, the spring will grip around a groove with steps 958 in shaft part 959 on carriage 960. On rotation there is then a stepwise movement of the operating element. The carriage 960 is movable relative to a frame 962. Two spring members 963 and 964 are immediately below the carriage at 963' and 964'. These are biased by two wire springs 965-965'. This means that the operating element remains in a centre position when it is not actuated. A sliding contact spring 968 is fastened to the carriage and is in contact with the contact fields on the circuit board. On a sliding movement of the operating element, the movement is detected by means of the movement of the spring from 971' to 972 or 972'. The reference numeral 973 refers to the direction of the sliding movement. As in the previously described solutions, rotation of the operating element is detected by a sliding contact spring 969 being in contact with the contact fields 971. The sliding contact spring is fastened to a rotary part 970 which in turn is fastened to the centre portion or central part 951 of the operating element. Reference numeral 974 refers to a ring which insulates contact in the centre from the rest of the contact field. As a skilled person will appreciate, force feedback systems can also be implemented for this solution. Here, it is obvious to adapt the solution described in connection with Fig. 68. With combinations of the rotary switches described in the description above and shown in the associated drawings, the solution could also easily be adapted for an addition four press and/or tilting positions.

Figs. 71a-71b depict a variation of the solutions shown in Figs. 46-47. The figure shows a roller switch where the operating element 980 is movable together with the magnetic part 982 of the motor. The windings 984 are fixed in this solution. Reference numerals 986 and 987 indicate the system for detection of rotation as shown in Fig. 47. Figs. 71a and 71b are respectively a sectional view and a plan view of the solution, whilst Fig. 71c is an exploded view of the perspective view in Fig. 71d.

Figs. 72a-72c show a variation where connection 990 and 991 for power and outlet of signals are arranged on each side of the switch. We also see in these figures that the movable switch part is secured by a ball joint 994. This ensures movement on depression as this movement is in reality in three directions. We see how springs and contact points 996-996" are distributed in a triangular shape. Fig. 72a is a section taken along the line LXXIIa-LXXIIa in Fig. 72b.

Fig. 73a shows the design of a roller switch with a force feedback system if it is desirable to have a large switch that can be operated by several fingers or a large

movement of fingers. The technical structure can otherwise be as described and shown earlier. The surface of the operating element 1000 has in this case a characteristic depression in the centre 1001 and a taper 1002-1002' on each side. This shape prevents the user from making incorrect presses. Fig. 73b shows purely schematically how the roller switch can be constructed.

Fig. 74 shows a variant of the belt switch and of what is shown and described in connection with Fig. 59. Both solutions have functions for rotation and five pressure position switch activation. The major differences will be described below. On rotation of the belt 1020 which rolls about cylinders 1021 and 1022, a spring-loaded ball 1024 will run over steps 1026 which are in end part 1027. See also Fig. 74 which also shows a combined step and detection solution. Central depression for this belt switch variant is firmly secured on a bridge 1032 which does not move with the frame 1030, but which by means of its ends remain fixed to the circuit board 1031.

Fig. 75 shows the principle for combined detection and rotating step movement for rotating switch solutions. This is an embodiment which could save parts in a rotary switch. Here, an example of use of a roller switch element 1040 is shown. Detection and step area 1041 consists of elevations 1042 which are made of or coated with an electrically conductive material. A spring-loaded metal ball 1043 rests against the area 1041. On rotation of the operating element 1040, a stepwise movement will be obtained. In addition, it will be possible to detect the rotation electronically in that, for example, every other elevation 1042 is connected to a common conductor (not shown), whilst other intermediate elevations 1042' are connected to another common conductor (not shown). On rotation of the roller, the ball will form stepwise contact between elevations that are associated with a respective common conductor, so that contact is formed between the two conductors each time it passes between the elevations. If the ball is connected via the spring to a third terminal, it will also be possible to detect direction of rotation, as the ball in one case forms contact between the two conductors, and in another case forms contact either with elevation 1040 or 1042.

Patent claims

1.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the device has a control element mounted on a slide which is movable in a first or second direction along a first axis against the action of spring force, where the slide at an end point for movement is designed to cooperate with an impulse generator for simulation of an intermittent or step movement, and where the control element is provided with a plurality of pressure points for actuating switches located on the slide on tilting or depression of the control element;

characterised in

- that the slide in addition is movable in a third or fourth direction in a second axial direction which forms an angle of 90° with the first axial direction and against the action of spring force, where the slide at an end point for such movement is designed to cooperate with an impulse generator for simulation of an intermittent or step movement. (FIG. 2)

2.

An operating device as disclosed in claim 1, characterised in

- that the slide is divided into a first and a second part which engage with each other in a feather and tongue configuration with respective first and second control elements tiltably supported on their slide part;
- that in the first axial direction the two parts are movable either together in the first or the second direction, or the first part is movable alone in the first direction and the second part is movable in the second direction;
- that in the second axial direction the two parts are movable independent of one another; and
- that each slide part at an end point for movement is designed for cooperation with an impulse generator. (FIG. 3)

3.

An operating device as disclosed in claim 2, characterised in

- that the first part is equipped with three switches that are actuatable by depression or downward tilting of the first control element; and

- that the second part is equipped with four switches that are actuatable by depression or downward tilting of the second control element. (FIG. 3)

4.

An operating device as disclosed in claim 3, characterised in

- that the one of the said four switches that is closest to the first control element is designed to serve also as a fourth switch for the first part. (FIG. 3)

5.

An operating device as disclosed in claim 1, characterised in

- that the control element is stepwise rotatable about a shaft on the slide. (FIG. 4)

6.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the device has a control element mounted on a slide which is movable in a first or second direction along a first axis against the action of spring force, where the slide at an end point for movement is designed to cooperate with an impulse generator for simulation of an intermittent or step movement, and where the control element is provided with a plurality of pressure points for actuating switches located on the slide on tilting or depression of the control element;

characterised in

- that the control element is stepwise rotatable about a shaft on the slide, the stepwise position of the control element either being detectable by means of a pair of sliding contacts designed to stepwise short-circuit contact points on the slide, or being detectable by means of contact balls which alternately actuate switches that are positioned stepwise relative to the stepwise rotation of the control element. (FIGS. 5a/5b)

7.

An operating device as disclosed in claim 6, characterised in

- that the slide in addition is movable in a third or fourth direction in a second axial direction which forms an angle of 90° with the first axial direction and against the action of spring force, where the slide at an end point for such movement is designed to cooperate with a pulse generator for simulation of an intermittent or step movement.

8.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the device has a control element mounted on a slide which is movable in a first or second direction along a first axis against the action of spring force, where the slide at an end point for movement is designed to cooperate with an impulse generator for simulation of an intermittent or step movement, and where the control element is provided with a plurality of pressure points for actuating switches located on the slide on tilting or depression of the control element;

characterised in

- that the control element is stepwise rotatable about a shaft on the slide; and
- that the slide in addition is movable in a third or fourth direction in a second axial direction which forms an angle of 90° with the first axial direction and against the action of spring force, where the slide at an end point for such movement is designed to cooperate with an impulse generator for simulation of an intermittent or step movement. (FIG. 5)

9.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the device has a spring-supported body that is supported relative to the operating device housing, and where the body on central depression or downward tilting at an respective end portion is designed to actuate a respective switch located in the housing,

characterised in

- that the body has in an upper portion a circular sector cross-section; and
- that a semi-circular control element is designed to ride on said upper portion and is slidably movable on said portion transverse to the longitudinal axis of the body between two end positions, the control element at respective end positions being designed to actuate a switch or force feedback means located in the housing, in order to simulate a stepwise rolling movement. (FIG. 6)

10.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a

motor vehicle, boat, ship, aircraft or the like, where the device has at least one control element that is rotatable relative to the device housing and which is designed on depression and/or tilting to operate various switch functions,
characterised in

- that stepwise positioned magnets or electromagnets are arranged on said housing, part thereof, or on a depressible carriage in the housing that is supported by switches which operate said switch functions in order on the turning or rotation of the control element to cooperate with a magnetic means on the control element to give an indication and/or detection (or determination) of the stepwise movement of the control element to give a force feedback and/or rotation. (FIG. 7)

11.
An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the device has a stepwise movable slide having a control element which is designed on depression and/or tilting to operate various switch functions,
characterised in

- that stepwise positioned magnets or electromagnets are arranged on the slide or the slide housing in order on movement of the slide to cooperate with a magnetic means on the housing or the slide respectively for indication or detection of the stepwise movements of the slide and the position of the slide relative to the housing. (FIG. 8)

12.
An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the device has a stepwise movable slide having a control element which is designed on depression and/or tilting to operate various switch functions,
characterised in

- that the switch functions are provided by contact foil portions on the device housing located under the slide, arms being connected to the control element operating button in order on activation thereof via the arms and catch springs to actuate a respective contact foil portion via ends on a spider that is movable together with the slide. (FIG. 9)

13.

An operating device as disclosed in claim 12, characterised in

- that located at at least one end of the slide path of the slide is a so-called toggle spring in order when the slide is pushed against the spring to provide, via said contact foil, a so-called "kick switch" function.

14.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or the controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the device has a slide with a control element which on tilting and/or depression causes activation of switch functions, and where the slide is movable from a neutral position to opposite extreme positions, characterised in

- that a spring means is provided on the slide, for example a cross-shaped spring, for cooperation with contact points located on the device housing at respective extreme positions and facing towards a slide surface; and
- that a return spring means is provided for moving the slide from an extreme position back to the neutral position. (FIG. 10)

15.

A operating device as disclosed in claim 14, characterised in

- that the contact points are on a contact foil.

16.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the device has a control element mounted on a slide which is stepwise movable along a first axial direction, and where the control element is provided with a plurality of pressure points for selectively actuating switches located on the operating device housing on tilting or depression of the control element,

characterised in

- that on its underside the control element is cross-shaped and has on each arm of the cross two switch actuating pins, so that on tilting of the control element two switches are always activated at a time by means of said pins, and on central

depression of the control element at least one, but at most four switches will be activated. (FIG. 11)

17.

An operating device as disclosed in claim 16, characterised in

- that the switches are formed by contact switches, e.g., made of a contact foil construction.

18.

A operating device as disclosed in claim 16 or 17,
characterised in

- that the slide is movable along, depressible and tiltable in four directions relative to two guide bars that extend though oval holes in the slide and are arranged in the device housing.

19.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the device has a control element mounted on a slide which is stepwise movable along a first axial direction, and where the control element is provided with a plurality of pressure points for selectively actuating switches located on the slide on tilting or depression of the control element characterised in

- that central depression of the control element is designed to activate a switch located centrally on the upper side of the slide;
- that the control element is operatively connected to a cruciform arm structure in order on selective tilting of the control element to actuate the non-central switches; and
- that downward tilting of the control element at a pressure point on one side relative to the centre of the control element is designed to activate a switch located on the underside of the slide on the diametrically opposite side of said centre. (FIG. 12)

20.

An operating device as disclosed in claim 19, characterised in

- that electrical connection with the switches on the slide is provided by busbars located on the device housing facing the underside of the slide, and sliding

contacts on the slide, and that the stepwise position of the slide is determined by means of a busbar and contact points in stepwise arrangement which cooperate with sliding contacts on the slide.

21.

An operating device according to claim 19 or 20, characterised in

- that a circuit board is housed in the slide.

22.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the device has a control element mounted on a slide which is stepwise movable along a first axial direction, and where the control element is provided with a plurality of pressure points for selectively actuating switches located on the slide on tilting or depression of the control element characterised in

- that the control element is operatively connected to a cruciform arm structure in order on selective tilting of the control element to actuate the non-central switches; and
- that central depression of the control element is designed to activate a switch that is located centrally on the slide, an actuating pin connected to the operating device control button sliding through a central hole in the arm structure. (FIG. 13)

23.

An operating device as disclosed in claim 22, characterised in

- that electrical connection with the switches on the slide is provided by busbars located on the device housing facing the underside of the slide, and sliding contacts on the slide, and that the stepwise position of the slide is determined by means of a busbar and contact points in stepwise arrangement which cooperate with sliding contacts on the slide.

24.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the device has a control element having an operating button that is stepwise rotatable about an axis and is provided with

a plurality of pressure points for selectively actuating switches located on a base member in the device housing on tilting or depression of the control element, characterised in

- that the control element comprises a cruciform arm structure in order on selective tilting of the control element to actuate a non-centrally located one of the switches;
- that central depression of the control element is designed to activate a switch located centrally on the base member;
- that the arm structure is supported by a spring means anchored to the base member; and
- that the turning of the operating button is detectable by means of a sliding contact and contact point device in connection with the underside of the operating button and the upper side of the arm structure. (FIG. 14)

25.

An operating device as disclosed in claim 24, characterised in

- that electrical connection between the base part and the sliding contacts is provided by wiring located in the spring means.

26.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the device has a first control element made in the form of an annular body that is stepwise rotatable about a second, non-rotatable control element, where the first control element is provided with a plurality of pressure points in order on depression at a selective one thereof to actuate a switch in a first set of switches located on a base member in the device housing, and where the second control element is provided with a plurality of pressure points in order on depression or tilting at a selective one thereof to actuate a switch in a second set of switches located on a base member in the device housing,
characterised in

- that on its underside the second control element comprises a plurality of switch actuating pins in order on selective tilting of the control element to actuate non-centrally located one of the switches, and on central depression of the control element is to activate a switch centrally located on the base member;
- that the second control element is supported by a spring means anchored to the base member; and

- that the turning of the first control element is detectable by means of a sliding contact and contact point device in cooperation between the underside of the first control element and an opposite portion of the device housing. (FIG. 15)

27

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the device has a control element that is stepwise rotatable about an axis, and where the operating device control button is provided with a plurality of pressure points for selectively actuating switches located on a base part in the device housing on tilting or depression of the control element characterised in

- that the control element is operatively connected to a cruciform arm structure having switch actuating pins at the ends of the arms or an annular structure having a plurality of switch actuating pins in order on selective tilting of the control element to actuate one of the switches that is non-centrally located. (FIG. 16)

28.

An operating device as disclosed in claim 24, characterised in

- that central depression of the control element is designed to activate a switch located centrally on the base part, an actuating pin connected to the control element operating button sliding through a central hole in the arm structure. (FIG. 16a)

29.

A operating device as disclosed in claim 27, characterised in

- that the turning of the operating button is detectable by means of a sliding contact and contact point device in connection with the underside of the operating button and an opposite portion of the device housing or on the base part.

30.

An operating device as disclosed in one or more of claims 27-29, characterised in

- that the operating button forms with the aid of a spring means spring engagement with an upper neck portion of the arm structure or a shoulder part of the annular structure; and
- that the neck portion has a corrugated circumference for causing with the aid of the spring means stepwise turning of the operating button.

31.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the device has a roller-shaped control element that is stepwise rotatable about a shaft and is provided with a plurality of pressure points for selectively actuating switches located on a base member in the device housing on tilting or central depression of the control element, characterised in

- that the control element is rotatably supported about a shaft in a cradle that is supported by three spring-equipped switches, one of the switches being on one side of the shaft and the two other switches being on the opposite side of the shaft;
- that central depression of the control element is designed to activate a switch located centrally on the base member; and
- that the turning of the control element is detectable by means of a sliding contact and contact point device in connection with an end member of the cradle and an end portion of the underside of the control element operating button and upper side of the arm structure. (FIG. 17; FIG. 36)

32.

An operating device as disclosed in claim 31, characterised in

- that the switches are selectively activatable by depression or tilting of the control element, whereby the underside of the cradle actuates the relevant switch.

33.

An operating device as disclosed in claim 28 or 29, characterised in

- that the shaft is supported in elongate holes in posts or side members that extend up from the base part or in the device housing.

34.
An operating device as disclosed in one or more of claims 31-33,
characterised in

- that the control element is displaceable along the shaft for activating an additional switch function.

35.
An operating device as disclosed in one or more of claims 31-34,
characterised in

- that the control element is curved inwards towards the shaft along a substantial part of the length of the control element.

36.
An operating device as disclosed in claim 35, characterised in

- that the inward curve has a radius of curvature that is equal to or greater than the length of the control element.

37.
An operating element as disclosed in claim 31 or 32,
characterised in

- that at least one switch is composed of a double switch construction consisting of two superimposed switch elements, each activated by different activation pressure. (FIGS. 17 m-o)

38.
An operating device as disclosed in one or more of claims 31-36,
characterised in

- that a second and a third control element respectively are hinge-connected to a respective long side of the cradle;
- that a spring-loaded switch is located between the base member and the underside of the said second and third control elements in order on depression to effect a supplementary switch function. (FIG. 18)

39.
An operating device as disclosed in claim 38,
characterised in

- that said second and third control elements are made in the form of a cradle in which an operating roller is stepwise rotatably supported about a shaft in the cradle, the shaft being transverse to the shaft of the first control element; and
- that the turning of the operating roller is detectable by means of a sliding contact and contact point device in connection with an end member of the cradle and an end portion of the operating roller. (FIG. 19).

40.

An operating device as disclosed in one or more of claims 31-36, characterised in

- that an annular control element is arranged so as to be stepwise rotatable about the roller-shaped control element and is spring-supported by at least three, preferably four, spring-equipped switches, depression of the annular control element at selected depression points causing activation of an adjacently arranged switch. (FIGS. 20a-c)

41.

An operating device as disclosed in claim 39, characterised in

- that an annular control element is arranged so as to be stepwise rotatable about the roller-shaped control element and said second and third control elements articulated to the cradle thereof, wherein the annular control element is spring-supported by at least three, preferably four, spring-equipped switches, depression of the annular control element at selected depression points causing activation of an adjacently arranged switch. (FIG. 20d)

42.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the device has a control element that is stepwise rotatable relative to the device housing, where the control element is provided with a plurality of pressure points in order on depression at a selective one thereof to actuate a switch in a set of switches located on a base member in the device housing, and where the control element in addition is movable sideways to activate a kick switch or toggle switch function,

characterised in

- that on its underside the base part is provided with a plurality of said kick switches or toggle switches;

- that the control element operating button is rotatably supported about a pivot that is supported with clearance via a central hole in the base member, and at its end is tiltable about a journal on said housing, a spider or a round disc being fixedly mounted at said end of the pivot;
- that when the button is pushed sideways in one direction the pivot is made to tilt, thus causing the spider or disc to activate a switch on the underside of the base member and which is located on one side of the pivot that is opposite to the direction of movement of the button. (FIG. 21)

43.

An operating device as disclosed in claim 42, characterised in

- that the turning of the operating button is detectable by means of a sliding contact and contact point device in connection with the underside of the operating button and an opposite portion on the base part.

44.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the device has a control element that is provided with a plurality of pressure points for selectively actuating switches located on the slide on tilting or depression of the control element
characterised in

- that the control element is operatively connected to a cruciform arm structure in order on tilting of the control element to actuate the non-central switches;
- that central depression of the control element is designed to activate a centrally located switch, an actuating pin connected to the control element operating button sliding through a central hole in the arm structure;
- that the control element is made in the form of a cradle in which are rotatably mounted at least two spaced-apart rollers over which an endless belt runs;
- that a means is associated with one of the rollers for detection of its stepwise rotation so as to give the operating device an additional control element function. (FIG. 22)

45.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the device has a control element

made in the form of a roller that is stepwise rotatable about a shaft relative to the device housing,
characterised in

- that the control element is curved inwards towards the shaft along a substantial portion of the length of the control element; and
- that the inward curve has a radius of curvature that is equal to or greater than the length of the control element (FIG. 17l)

46.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the device has a control element made in the form of a preferably slidably movable operating button,
characterised in

- that the operating button has a surface made having an essentially concave finger rest portion, and that the concave portion is made having at least one of the following finger friction or engaging elements: studs, rings, crescent-shaped protrusions, or is made having a corrugated structure consisting of a plurality of pyramid-shaped studs or depressions. (FIGS. 23-28)

47.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the device has a control element made in the form of a preferably slidably movable operating button,
characterised in

- that the operating button has a surface made having four distinct finger engaging or friction contact faces for tilting movement of the control element. (FIG. 27)

48.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the device has a control element which is stepwise rotatable relative to the device housing, where the control element is provided with a plurality of pressure points in order on depression or tilting at a selective one thereof to actuate a switch in a set of switches,

characterised by

- a means for preventing rotation of the control element on said tilting or depression. (FIGS. 29-31)

49.

An operating device as disclosed in claim 48, characterised in

- that said means is provided by clamping wedging action relative to the device housing or a cradle/support in which the control element is rotatably arranged, or is provided by pins which form releasable engagement between the control element and said housing, cradle or support. (FIGS. 32-34)

50.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the device has a control element which is arranged on a cradle and where the control element is provided with a plurality of pressure points for selectively actuating switches located on the operating device housing or on a base member on depression or tilting of the control element characterised in

- that the control element is a roller that is rotatably supported about a shaft in the cradle; and
- that the rotation of the control element is detectable by means of a sliding contact and contact point device in connection with an end member of the cradle and an end portion of the control element. (FIG. 35)

51.

An operating device as disclosed in claim 50, characterised in

- that the switches are formed of a contact foil construction.

52.

An operating device as disclosed in claim 50 or 51,
characterised in

- that the cradle is depressible and tiltable relative to two guide bars that extend through oval holes in the cradle, the bars being supported in oval holes in posts or members that project up from a base part or that are arranged in the device housing.

53.
An operating device as disclosed in claim 50 or 51,
characterised in

- that the switches are selectively activatable on depression or tilting of the control element, whereby the underside of the cradle actuates the relevant switch.

54.
An operating device as disclosed in one or more of claims 50-53,
characterised in

- that the control element is curved inwards towards the shaft along a substantial portion of the length of the control element.

55.
An operating device as disclosed in claim 54, characterised in

- that the inward curve has a radius of curvature that is equal to or greater than the length of the control element.

56.
An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the device has a control element which is provided with a plurality of pressure points for selectively actuating switches located on the upper side or underside of an engagement block in the device housing on depression or tilting of the control element,
characterised in

- that central depression of the control element is designed to activate a switch located centrally on the upper side of the block;
- that the control element is operatively connected to a cruciform arm structure in order on selective tilting of the control element to actuate non-centrally located ones of the switches; and
- that downward tilting of the control element at a pressure point on one side relative to the centre of the control element is designed to activate a switch located on the underside of the block on a diametrically opposite side of said centre. (FIG. 12e)

57.
An operating device as disclosed in claim 54, characterised in

- that a stepwise rotatable operating button is incorporated in the control element; and
- that a means is provided for detecting the rotation of the operating button.

58.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the device has a control element provided with a plurality of pressure points for selectively actuating switches located on the operating device housing or on a base member in the housing on depression or tilting of the control element,

characterised in

- that on its underside the control element is cruciform and has on each arm of the cross two switch actuating pins, so that on tilting or central depression of the control element two switches are always activated at a time by means of said pins. (FIG. 11k-m)

59.

An operating device as disclosed in claim 58, characterised in

- that a stepwise rotatable operating button is incorporated in the control element; and
- that a means is provided for detecting rotation of the operating button.

60.

An operating device as disclosed in claim 58, characterised in

- that the switches are formed of a contact foil construction.

61.

An operating device as disclosed in claim 16 or 17,

characterised in

- that the control element is depressible and tiltable in four directions relative to two guide bars that extend through oval holes in the control element and are arranged in the device housing.

62.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a

motor vehicle, boat, ship, aircraft or the like, where the device has a control element which is provided with a plurality of pressure points for selectively actuating switches located on the operating device housing or on a base member in the housing on depression or tilting of the control element,
characterised in

- that the control element cooperates with or forms a part of a step motor; and
- that the step motor is designed to carry out operations selected from the group: controlling the number of steps, controlling the distance between steps, controlling the force a user needs to apply, braking or stopping movement of the control element, causing a back or return movement, stimulating or oscillating (small reciprocating motions), detecting movement and direction of movement. (FIGS. 37-38; FIGS. 39-45)

63.
An operating device as disclosed in claim 62, characterised in

- that the step motor casing forms a part of the control element; and
- that the step motor shaft is designed to be kept stationary.

64.
An operating device as disclosed in claim 62, characterised in

- that the step motor shaft is connected to the control element; and
- that the step motor casing is arranged to be stationary.

65.
An operating device as disclosed in claim 62, 63 or 64,
characterised in

- that a rotation detector is mounted in association with the step motor to detect mutual rotation between the motor casing and the shaft.

66.
An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship aircraft or the like, where the device has a control element provided with a plurality of pressure points for selectively actuating switches located on the operating device housing or on a base member in the housing on depression and/or tilting of the control element,
characterised in

- that the control element is a stepwise rotatable operating button or disc which has a diameter d in millimetres, and where the number of steps the operating button/disc can be turned is n;
- that a constant $k \in [d/n)]$; and
- that k = 1.7 - 2.4 mm per number of steps. (FIG. 16c]

67.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the device has a control element provided with a plurality of pressure points for selectively actuating switches located on the operating device housing or on a base member in the housing on depression and/or tilting of the control element,

characterised in

- that the control element is a stepwise rotatable roller or drum which has a largest diameter d in millimetres, and where the number of steps the roller or drum can be turned is n;
- that a constant $k \in [d/n)]$; and
- that k = 1.5 - 2.0 mm per number of steps. (FIG. 18c]

68.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the device has a means for force feedback,

characterised in

- that the operating device has a roller-shaped, rotatable control element, where rotation of the control element is detectable and where the control element consists of an outer part of a DC electromotor or step motor installed inside the operating device, where the motor is designed on controlled power supply to give on manually actuated rotation of the control element a counterforce selected from the group: pulsed counterforce adapted to the gradual rotation of the control element, steady counterforce, gradually increasing counterforce, gradually decreasing counterforce. (Fig. 46; Fig. 47; Fig. 71)

69.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the device has a means for force feedback,

characterised in

- that the operating device has a roller-shaped, rotatable control element, where rotation of the control element is detectable, where the control element forms operative engagement with a DC electromotor or step motor by means of mechanical transmission to an internal end portion of the control element or the the control element shaft, where the motor is designed on controlled power supply to give on manually actuated rotation of the control element a counterforce selected from the group: pulsed counterforce adapted to the gradual rotation of the control element, steady counterforce, gradually increasing counterforce, gradually decreasing counterforce. (Figs. 49a-49d; Figs. 50a-52b)

70.

An operating device as disclosed in claim 68, characterised in

- that the mechanical transmission between the motor and the internal end portion of the control element is via a gearwheel/gear rim engagement. (Figs. 49a-49d)

71.

An operating device as disclosed in claim 69, characterised in

- that the mechanical transmission between the motor and the control element shaft is selected from the group: a Bowden cable connection, a wire connection, a connecting element of a flexible material or structure, a universal joint connection, a gearwheel connection, a belt drive, a toothed belt drive. (Figs. 50a-52b)

72.

An operating device as disclosed in claim 68 or 69,

characterised in

- that rotation of the control element is detectable by means of a device selected from the group: a Hall sensor; a resistance measuring device current; contact field sliders; an optical detector in cooperation with a rotatable disc provided with an

optically readable pattern; a magnetic field detector in cooperation with a magnetically coded, rotatable disc; a light detector in cooperation with a rotatable, stepwise perforated disc. (Figs. 48a-48f)

73.

An operating device as disclosed in one or more of preceding claims 68-72, characterised in

- that the control element is supported in a cradle or support and for actuation of a respective switch function is depressible at a centre portion and/or at respective ends. (Figs. 47g-47i)

74.

An operating device as disclosed in one or more of preceding claims 68-73, characterised in

- that the control element is designed to form operative cooperation with two or four switches arranged externally in relation to the operating device for operating a respective operative switch function. (Figs. 47j-47u)

75.

An operating device as disclosed in claim 74, characterised in

- that one external switch is provided at each axial end area of the operating device and/or one external switch on opposite long sides of the operating device.

76.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the device has a means for force feedback,

characterised in

- that the operating device has a button-like, rotatable control element having four or five depression points or a central depression point and four-way tilting for selective actuation of a respective operative switch function;
- that the control element forms operative engagement with a DC electromotor or step motor by means of mechanical transmission to a peripheral portion or a central portion of the control element, where the motor is designed on controlled power supply to give on manually actuated rotation of the control element a counterforce selected from the group:

pulsed counterforce adapted to the gradual rotation of the control element, steady counterforce, gradually increasing counterforce, gradually decreasing counterforce. (Figs. 53a-53c; 54a-54c)

77.

An operating device as disclosed in claim 76, characterised in

- that the mechanical transmission between the motor and said peripheral portion in by gearwheel engagement with a toothed periphery of the control element or by belt drive. (Figs. 53a-53c)

78.

An operating device as disclosed in claim 76, characterised in

- that the mechanical transmission to the central portion of the control element is via a ball joint having engagement pins. (Fig. 54a-54c)

79.

An operating device as disclosed in claim 76, 77 or 78, characterised in

- that rotation of the control element is detectable, e.g., by means of contact field sliders in association with the control element or via manually actuated rotation of the motor.

80.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, characterised in

- that the operating device has a uniform, button-like, rotatable control element having one central depression point, and in a peripheral portion four depression points or the possibility of four-way tilting for selective actuation of a respective operative switch function;
- that the control element is designed for stepwise rotation that is detectable by means of a rotation detector, e.g., made in the form of current contact field sliders;
- that the control element is designed when depressed to activate via a central rotatable stem a centrally located switch; and

- that a spider or an arm-provided block is arranged non-rotatably, but is slidable in relation to said stem in order on tilting or depression of the control element at the peripheral portion to tilt for actuation of a respective switch arranged in the peripheral portion of the operating device. (Figs. 55-57c)

81.

An operating device according to claim 80, characterised in

- that the rotation detector seen radially is in an area between the central switch and the four switches in the peripheral portion of the operating device. (Figs. 55; 56a-56d)

82.

An operating device as disclosed in claim 80, characterised in

- that the rotation detector seen radially is in an area beyond the four switches at the peripheral portion of the operating device. (Figs. 57a-57c)

83.

An operating device as disclosed in claim 80 or 81,
characterised in

- that the four switches at the peripheral portion of the operating device are in a first plane; and
- that the centrally located switch and the rotation detector are in a second plane. (Figs. 55; 56a-56d)

84.

An operating device as disclosed in claim 80, 81 or 82,
characterised in

- that the four switches in the peripheral portion of the operating device, the centrally located switch and the rotation detector are in the same plane. (Figs. 55-57c)

85.

An operating device as disclosed in any one of claims 80-84,
characterised in

- that the control element is mounted so as to be stepwise rotatable about a non-rotatable frame part, the control element having a rotatable tilting and pressure part which supports a spring forming yielding engagement with a polygonal

element on the frame part for marked stepwise movement of the control element. (Figs. 56a-56d)

86.

An operating device as disclosed in claim 80, characterised in

- that the arm-provided block has a polygonal peripheral portion that forms yielding engagement with a spring located on a rotary part on which the control element is fastened for marked stepwise movement of the control element. (Figs. 57a-57c)

87.

An operating device as disclosed in one or more of claims 80, 81, 83-85, characterised in

- that the central stem is designed to be depressed against the action of an elastic, compressible element. (Fig. 56c)

88.

An operating device as disclosed in one or more of preceding claims 80-87, characterised in

- that the control element forms operative engagement with a DC electromotor or step motor by means of a mechanical transmission from the motor to a central portion of the control element;
- that the motor is designed on controlled power supply to give on manually actuated rotation of the control element a counterforce (force feedback) selected from the group: pulsed counterforce adapted to the gradual rotation of the control element, steady counterforce, gradually increasing counterforce, gradually decreasing counterforce; and
- that the centrally located switch has for provision of the mechanical transmission a central perforation for the lead-through of a motor shaft extension for rotational engagement with a wholly or partly axially extending opening in the central stem, the motor shaft extension preferably being made of an elastically yielding material or is tiltably or articulately connected to the motor shaft. (Fig. 55)

89.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a

motor vehicle, boat, ship, aircraft or the like, where the operating device has a first, stepwise rotatable control element which encircles a second, non-rotatable, centre position deviation movable control element, where the first control element is designed on depression or tilting to actuate a respective switch of four switches located in the peripheral area of the operating device, where a rotation detector is provided for detecting the stepwise rotation of the first control element, and where the second switch on centre position deviation is designed to actuate a centre position deviation detector, characterised in

- that the second control element on central depression is in addition designed to actuate a centrally located switch;
- that the central switch and the four switches in the peripheral area of the operating device are located in a same, first plane;
- that the centre position deviation detector is located in a second plane below and parallel to the first plane; and
- that the central switch has a central opening for passage of a pin which forms a connection between an operating button on the second control element and the centre position deviation detector. (Figs. 58a-58d)

90.

A operating device as disclosed in claim 89, characterised in

- that the centre position deviation detector consists of a set of strain gauges arranged in a cross shape on a fixed, thin disc, and where said pin is anchored in the disc at the centre of the set of strain gauges. (Figs. 58a-58d)

91.

An operating device as disclosed in claim 89 or 90,
characterised in

- that the rotation detector is of a type based on current contact field and current contact field sliders. (Fig. 58d)

92.

An operating device as disclosed in claim 80, characterised in

- that the rotation detector seen radially is located in an area between the central switch and the four switches in the peripheral portion of the operating device. (Fig. 58d)

93.

An operating device as disclosed in one or more of claims 89-92, characterised in

- that the four switches in the peripheral portion of the operating device, the centrally located switch and the rotation detector are in the same plane. (Fig. 58d)

94.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the operating device has an endless belt that is passed around two spaced-apart, stepwise rotatable rollers mounted on a common support structure, and where stepwise rotation of the rollers caused by manual pushing on the belt is detectable by means of a rotation detector, characterised in

- that incorporated in the operating device is a bridge piece that extends transverse to the underside of the upper face of the belt with the centre of the bridge piece approximately half way between the rollers; and
- that the bridge piece is provided with a plurality of m switches, optionally with a superjacent sliding belt cover, for directly actuating a respective switch function on selective depression on the belt. (Figs. 59, 60a-60c, 60e-60g, 74)

95.

An operating device as disclosed in claim 94, characterised in

- that the support structure supporting the bridge piece is mounted on a frame which is torsionally stable relative to an underlying base part, but is tiltable relative to and spring-supported by the base part, e.g., a circuit board. (Fig. 59)

96.

An operating device as disclosed in claim 94 or 95, characterised in

- that mounted on the base part is a plurality of n switches for actuating a respective switch function on tilting of the support and thus the frame. (Fig. 59; Fig. 74)

97.

An operating device as disclosed in claim 94, characterised in

- that m = 1, 2, 3, 4 or 5. (Figs. 59, 60a-60c, 60e-60g, 74)

98.
An operating device as disclosed in claim 96, characterised in
- that n = 2 or 4. (Figs 59; 74)

99.
An operating device as disclosed in claims 97 and 98,
characterised in
- that m and n are selected from the group: m = 1, n = 2; m = 2, n = 2; m = 3, n = 2; m = 1, n = 4. (Figs. 60i-60yy; 74)

100.
An operating device as disclosed in claim 99, characterised in
- that the n switches are located in an axial direction beyond the respective end of a roller; and
- that n = 2. (Figs. 60c, 60d, 60f)

101.
An operating device as disclosed in claim 94, 97, 98 or 99,
characterised in
- that located adjacent to the operating device is a switch parallel to the axis of each roller and/or a switch parallel to each long side of the operating device for actuating a respective switch function. (Figs. 60m, 60q, 60s-60u, 60w-60yy)

102.
An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the operating device has an endless belt that is passed around two spaced-apart, stepwise rotatable rollers mounted on a common support structure, and where stepwise rotation of the rollers caused by manual pushing on the belt is detectable by means of a rotation detector,
characterised in
- that the support is mounted on a frame that is torsionally stable relative to an underlying base part, but is tiltable relative to and spring-supported by the base part, e.g., a circuit board; and
- that mounted on the base part is a plurality of n switches for actuating a respective switch function on tilting of the support and thus the frame. (Fig. 59)

103.

An operating device as disclosed in claim 102, characterised in

- that n = 2 or 4.

104.

An operating device as disclosed in claim 103, characterised in

- that the n switches are located in an axial direction beyond the respective end of a roller; and
- that n = 2. (Figs. 60c, 60d, 60f)

105.

An operating device as disclosed in claim 102, 103 or 104, characterised in

- that located adjacent to the operating device is a switch parallel to the axis of each roller and/or a switch parallel to each long side of the operating device for actuation of a respective switch function. (Fig. 60t)

106.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the operating device has an endless belt that is passed around two spaced-apart, stepwise rotatable rollers mounted on a common support structure, and where stepwise rotation of the rollers caused by manual pushing on the belt is detectable by means of a rotation detector, characterised in

- that located adjacent to the operating device is a switch parallel to the axis of each roller and/or a switch parallel to each long side of the operating device for actuating a respective switch function. (Figs. 60l, 60m, 60u)

107.

An operating device as disclosed in any one of claims 94-106, characterised in

- that in connection with at least one of the rollers there is provided a force feedback means selected from the group:

- a DC electromotor or step motor incorporated into the roller, where the motor is designed on controlled power supply to give on manually actuated rotation of the roller a counterforce selected from the group: pulsed counterforce adapted to the gradual rotation of the control element, steady counterforce, gradually increasing counterforce, gradually decreasing counterforce;
- the roller in operative engagement with a DC electromotor or step motor by means of mechanical transmission to an internal end portion of the roller or to the roller shaft, where the motor is designed on controlled power supply to give on manually actuated rotation of the roller a counterforce selected from the group: pulsed counterforce adapted to the gradual rotation of the control element, steady counterforce, gradually increasing counterforce, gradually decreasing counterforce. (Fig. 59; Figs. 60d, 60f)

108.

An operating device as disclosed in claim 107, characterised in

- that the mechanical transmission between the motor and the internal end portion of the control element is via a gearwheel/gear rim engagement.

109.

An operating device as disclosed in claim 107, characterised in

- that the mechanical transmission between the motor and the control element shaft is selected from the group: a Bowden cable connection, a wire connection, a connecting element of flexible material or structure, a universal joint connection, a gear connection, a belt drive, a toothed belt drive.

110.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the operating device has an endless belt that is passed around two spaced-apart, stepwise rotatable rollers mounted on a common support structure, and where stepwise rotation of the rollers caused by manual pushing on the belt is detectable by means of a rotation detector,
characterised in

- that the rotation detector consists of at least one mechanical arm, the end of which forms stepwise releasable engagement with pins or ridges on the periphery of one of the rollers, and where the arm cooperates with a strain detector mounted on the arm, e.g., of the strain gauge type or the piezoelectric

type. (Figs. 61a, 61b)

111.

An operating device as disclosed in claim 110, characterised in

- that the belt is designed to have at all times mutually synchronous movement with the roller, the roller forming toothed engagement with a toothed rear side of the belt.

112.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the operating device has an endless belt that is passed around two spaced-apart, stepwise rotatable rollers mounted on a common support structure, and where stepwise rotation of the rollers caused by manual pushing on the belt is detectable by means of a rotation detector,
characterised in

- that the rotation detector consists of at least one magnetic field detector designed to detect magnets arranged stepwise on the periphery of the roller. (Fig. 61e)

113.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the operating device has an endless belt that is passed around two spaced-apart, stepwise rotatable rollers mounted on a common support structure, and where stepwise rotation of the rollers caused by manual pushing on the belt is detectable by means of a rotation detector,
characterised in

- that the rollers are arranged to have at all times mutually synchronous movement, the rollers either forming toothed engagement with a toothed rear side of the belt, or each being pivotally connected to a common connection bar. (Figs. 61c, 61d)

114.

An operating device as disclosed in any one of claims 68-79,
characterised in

- that the roller-shaped control element in connection with its surface has a capacative sensor for initiating a switch function in order to cut in or cut out power supply to the motor in connection with a power saving function. (Fig. 62a)

115.

An operating device as disclosed in any one of claims 68-79, characterised in

- that the roller-shaped control element is designed to cooperate with an optical detector which in the presence or absence of a user's finger close to or on the surface of the control element is designed to initiate a switch function in order to switch on and switch off power supply to the motor in connection with a power saving function. (Fig. 62b)

116.

An operating device as disclosed in any one of claims 68-79, 114 and 115, characterised in

- that the roller-shaped control element is designed to cooperate with a braking mechanism or a locking mechanism located at an end area of the control element, for locking the control element against rotation when it is not in use or during navigation in a menu. (Fig. 63)

117.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the operating device has a stepwise movable slide having a control element that is designed on depression and/or tilting to operate a respective switch function of various switch functions, where the switch functions are provided by contact foil portions on the device housing located under the slide, arms being connected to the control element operating button in order on activation thereof via the arms and catch springs to actuate a respective contact foil portion via ends on a spider that is movable together with the slide, the control element in each step position of the slide being arranged to operate selectively one of four switch functions,

characterised in

- that in each step position an additional, fifth possible switch function is provided, the control element being centrally depressible against the action of

catch spring in order via a pin that is movable through a block connecting the arms and a hole through the centre of the spider to actuate a switch function related to a respective contact foil portion. (Figs. 65a-65c)

118.

An operating device as disclosed in claim 117, characterised in

- that arranged on the slide are two spring-loaded contact balls which on the stepwise movement of the slide are designed to activate in each step their respective switch function related to a respective contact foil portion.

119.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the operating device has a stepwise movable slide having a control element that is designed on depression and/or tilting to operate a respective switch function of various switch functions, characterised in

- that is a force feedback means in the form of a DC electromotor or step motor is arranged in connection with the slide with the aid of mechanical transmission to the slide, the motor being designed on controlled power supply to give on manually actuated stepwise movement of the slide a counterforce selected from the group: pulsed counterforce adapted to the gradually rotation of the control element, steady counterforce, gradually increasing counterforce, gradually decreasing counterforce. (Figs. 66a-66c)

120.

An operating device as disclosed in claim 199, characterised in

- that the mechanical transmission between the motor and the slide is either via gearwheel/rack engagement, or via operation using a toothed belt, toothed band, wire or chain passed via a driving wheel and an idler wheel. (Figs. 66a-66c)

121.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the operating device has a control element located on a slide which is movable in a first or second direction along a first axis against the action of a spring force, where the slide at an end point for movement is

designed to cooperate with an impulse generator for simulation of intermittent or step movement, and where the control element is provided with four pressure points for actuating switches located on the slide for operating a respective switch function on tilting or depression of the control element,

characterised in

- that in each position of the slide there is an additional, fifth possible switch function, the control element being centrally depressible against the action of a catch spring for actuation of a switch function associated with a switch centrally located on the slide. (Fig. 67)

122.

A device as disclosed in claim 121, characterised in

- that the switch functions are provided by contact foil portions on the device housing located under the slide, arms being connected to the control element operating button in order on activation thereof via the arms and catch springs to actuate a respective contact foil portion via ends on a spider which is movable together with the slide, the control element in each step position of the slide being designed to operate selectively one of four switch functions, and
- that the control element against the action of the catch spring is centrally depressible in order via a pin that is movable through a block connecting the arms and a hole through the centre of the spider to actuate a switch function related to a respective contact foil portion.

123.

An operating device as disclosed in claim 122, characterised in

- that arranged on the slide are two spring-loaded contact balls which on movement of the slide are designed to activate at each position of the slide their respective switch function related to a respective contact foil portion.

124.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, characterised in

- that the operating device has a uniform, button-like control element having one central depression point, and in a peripheral portion four depression points or the possibility for four-way tilting for selective actuation of a respective operative switch function;

- that the control element is designed to activate via a central stem a centrally located switch when depressed; and
- that a spider or arm-provided block is arranged in slidable relation to said stem in order on tilting or depression of the control element in a peripheral portion to tilt for actuation of a respective switch arranged in the edge portion of the operating device. (Figs. 53a, 57, 65, 66b)

125.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the operating device has a control element that is designed on depression and/or tilting to operate a respective switch function of various switch functions, where the switch functions are provided by contact foil portions on the device housing, arms being connected to the control element operating button in order on activation thereof via the arms and catch springs to actuate a respective contact foil portion via ends on a spider, the control element being designed to operate a selective one of four switch functions,
characterised in

- that there is provided in an additional, fifth possible switch function, wherein the control element against the action of a catch spring is centrally depressible in order via a pin that is movable through a block connecting the arms and a hole through the centre of the spider to actuate a switch function related to a respective contact foil portion. (Figs. 65, 66)

126.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the operating device has a slidable control element having four tilting positions and the possibility of central depression order on tilting or depression to operate a respective switch function,
characterised in

- that the operating device has a means for force feedback;
- that the operating device is can be moved backwards and forwards relative to a neutral position, where the sliding movement is actuated by an electromotor or step motor for initiating and simulating a "step feeling";
- that the extent and speed of the sliding movement are measurable by means of a device selected from the group: a Hall sensor; a resistance measuring device;

contact field sliders; an optical detector in cooperation with a rotatable disc provided with an optically readable pattern; a magnetic field detector in cooperation with a magnetically coded, rotatable disc; a light detector in cooperation with a rotatable, stepwise perforated disc; and

- that the "step feeling" formed by the motor is variable in sequence because of the extent of the slide. (Fig. 68)

127.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the operating device has a uniform button-like, rotatable control element having one central depression point, and in a peripheral portion four depression points or the possibility for four-way tilting for selective actuation of a respective, operative switch function, and where the control element is designed via a central stud on depression to activate a centrally located switch,

characterised in

- that a spider or arm-provided block is arranged to be stationary relative to a switch-provided circuit board that is tiltable when the control element is tilted, whereby the spider or block in cooperation with the circuit board actuates a respective switch on the circuit board:
- that the operating device has a means for force feedback;
- that the rotational movement of the control element is actuated by an electromotor or step motor for initiating and simulating a "step feeling";
- that the angular extent and speed of the rotational movement are measurable; and
- that the "step feeling" generated by the motor due toactuated rotation is variable in frequency. (Fig. 69)

128.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the device has a control element located on a slide that is movable in a first or second direction relative to a central position along a first axis against the action of spring force, and where the control element is on depression thereof designed to actuate switches located on the slide, characterised in

- that the control element is stepwise rotatable about a shaft on the slide, the stepwise position of the control element either being detectable by means of a pair of sliding contacts designed to stepwise short-circuit contact points on the slide, or being detectable by means of contact balls which alternately actuate switches that are positioned stepwise related to the stepwise rotation of the control element. (Fig. 70)

129.

An operating device as disclosed in claim 128, characterised in

- that the slide at an end point for movement is designed to cooperate with an impulse generator for simulation of an intermittent or step movement.

130.

An operating device as disclosed in claim 128, characterised in

- that the control element in addition has a tilting function in order on depression or tilting in a peripheral area to actuate respective switches located on the slide.

131.

An operating device as disclosed in one or more of claims 128-130, characterised in

- that the operating device has a means for force feedback;
- that the stepwise rotational movement of the control element is actuated by an electromotor or a step motor for initiating and simulating a "step feeling";
- that the angular extent and speed of the rotational movement are measurable; and
- that the "step feeling" generated by the motor due to actuated rotation is variable in frequency.

132.

An operating device as disclosed in claim 68, characterised in

- that the operating device control element is movable together with the magnetic part of the motor; and
- that the winding part of the motor is arranged so as to be stationary in the operating device. (Fig. 71)

133.

An operating device as disclosed in claim 68, characterised in

- that the operative device control element is movable with the winding part of the motor; and
- that the magnetic part of the motor is arranged so as to be stationary in the operating device. (Fig. 46; Fig. 47)

134.

An operating device as disclosed in one or more of claims 31-41, 50, 68-73, 132 and 133, characterised in

- that the cradle in which the operating device control element is supported is connected to the operating device base member via a ball joint connection. (Fig. 71; Fig. 72)

135.

An operating device as disclosed in one or more of claims 31-41, 50, 68-73, 132 and 133, characterised in

- that the motor has terminals for power and movement-related signals at respective axial end areas. (Fig. 72)

136.

An operating device as disclosed in one or more of claims 31-41, 50, 68-73, 132-134, characterised in

- that the control element has an axial length that exceeds the axial length of the motor;
- that the control element at a central portion has a circumferential depression; and
- that the parts of the control element that extend from the central portion towards respective ends of the control element have a gradually decreasing diameter. (Fig. 73)

137.

An operating device as disclosed in claim 94, characterised in

- that the support is mounted on a frame which is torsionally stable relative to an underlying base part, but is tiltable relative to and spring-supported by the base part, e.g., a circuit board; and
- that the bridge piece at its ends is fastened to the base part. (Fig. 74)

138.

An operating device as disclosed in claim 137, characterised in

- that on the base part is arranged a plurality of n switches in order on tilting the support and thus the frame to actuate a respective switch function. (Fig. 74)

139.

An operating device as disclosed in claim 138, characterised in

- that n = 2 or 4. (Fig. 74)

140.

An operating device as disclosed in any one of claims 137-139, characterised in

- that in connection with at least one of the rollers there is provided a force feedback means selected from the group:
- a DC electromotor or step motor incorporated in the roller, where the motor is designed on controlled power supply to give on manually actuated rotation of the control element a counterforce selected from the group: pulsed counterforce adapted to the gradual rotation of the control element, steady counterforce, gradually increasing counterforce, gradually decreasing counterforce;
- the roller in operative engagement with a DC electromotor or step motor by means of a mechanical transmission to an internal end portion of the roller or to the shaft of the roller, where the motor is designed on controlled power supply to give on manually actuated rotation of the control element a counterforce selected from the group: pulsed counterforce adapted to the gradual rotation of the control element, steady counterforce, gradually increasing counterforce, gradually decreasing counterforce.

141.

An operating device for controlling user functions in electronic user equipment in interaction with a display screen, and/or for controlling a means of transport, e.g., a motor vehicle, boat, ship, aircraft or the like, where the device has a control element in the form of a controllable roller or drum or where the control element has an endless belt running around two spaced-apart rollers in a support, and where the control element is provided with a plurality of pressure points for selectively actuating switches located on the operating device housing or on a base member in the housing on tilting and/or depression of the control element

characterised in

- in that an end area of the control element has a plurality of electrically conducting, radially extending elevations;
- that every other elevation is connected to a first terminal;
- that the other elevations are connected to a second terminal; and
- that there is provided a spring-loaded, electrically conducting ball resting against the end area, so that it successively on the stepwise movement of the control element forms contact with successive pairs of elevations, where the elevations in the pair have respective contact with said first and second terminal, whereby the stepwise movement is electrically registrable. (Fig. 75)

142.

An operating device as disclosed in one or more of claims 1-141, characterised in

- that the operating device has a means for force feedback;
- that the number of stepwise rotational movements or stepwise sliding movements given through the system by force feedback is limited by functions that are available, and as shown on the screen in an interactive system;
- that the magnitude of available movement is controlled by using force feedback dependent upon available functions;
- that the magnitude of frequencies for initiating and simulating a "step feeling" is contingent upon the number of functions, available data and force applied to the operating element. (Fig. 64)

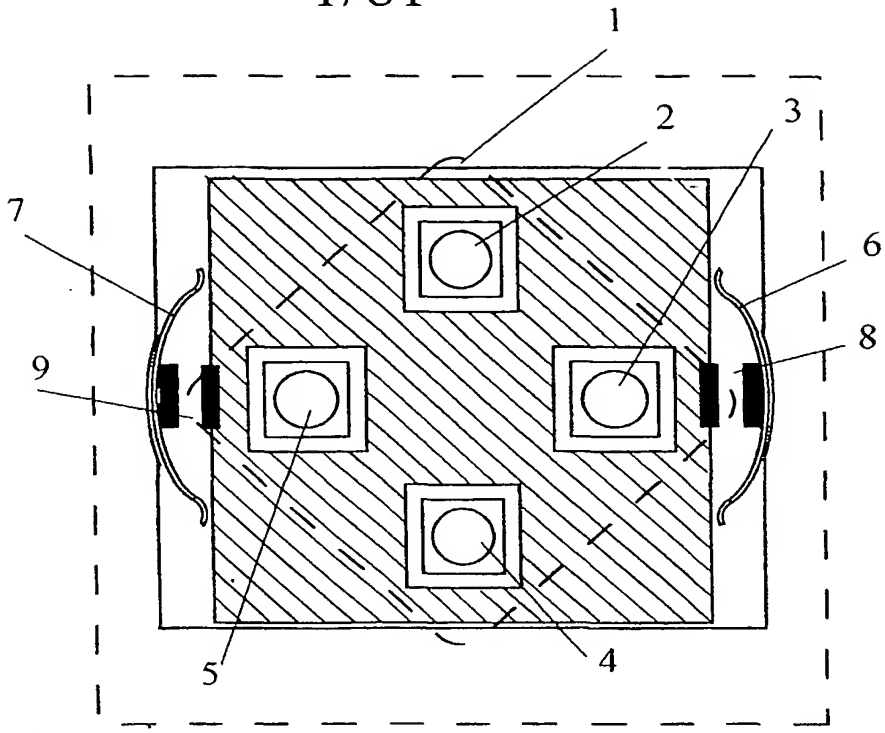


Fig. 1a
(Prior art)

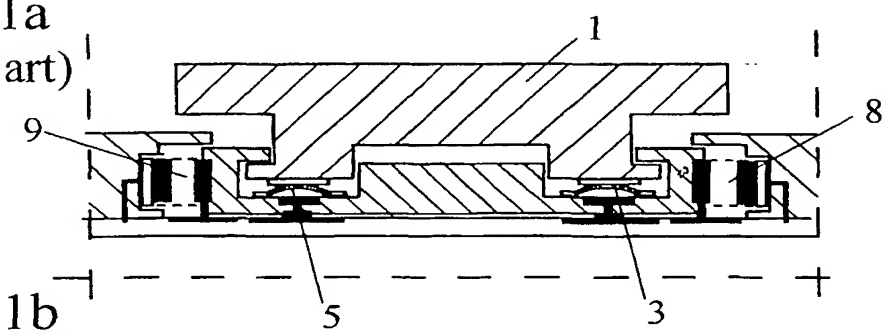


Fig. 1b
(Prior art)

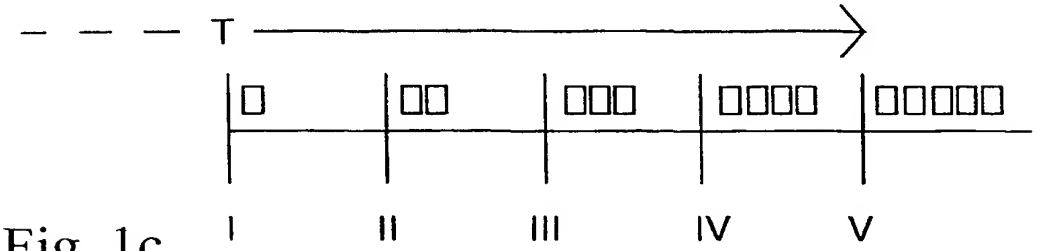


Fig. 1c
(Prior art)

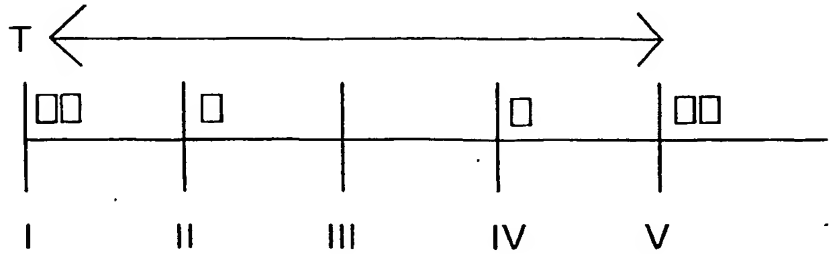


Fig. 1d
(Prior art)

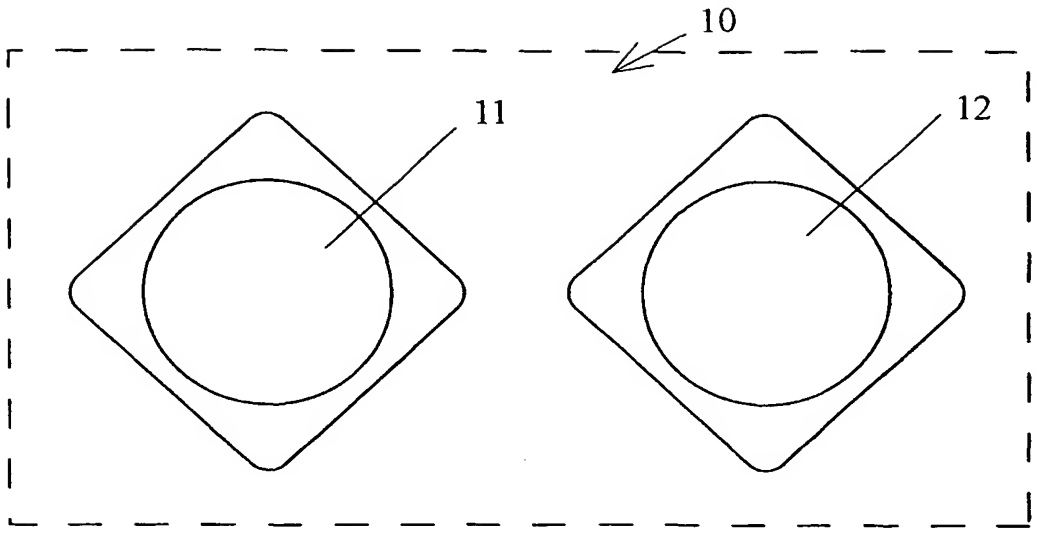


Fig. 2a

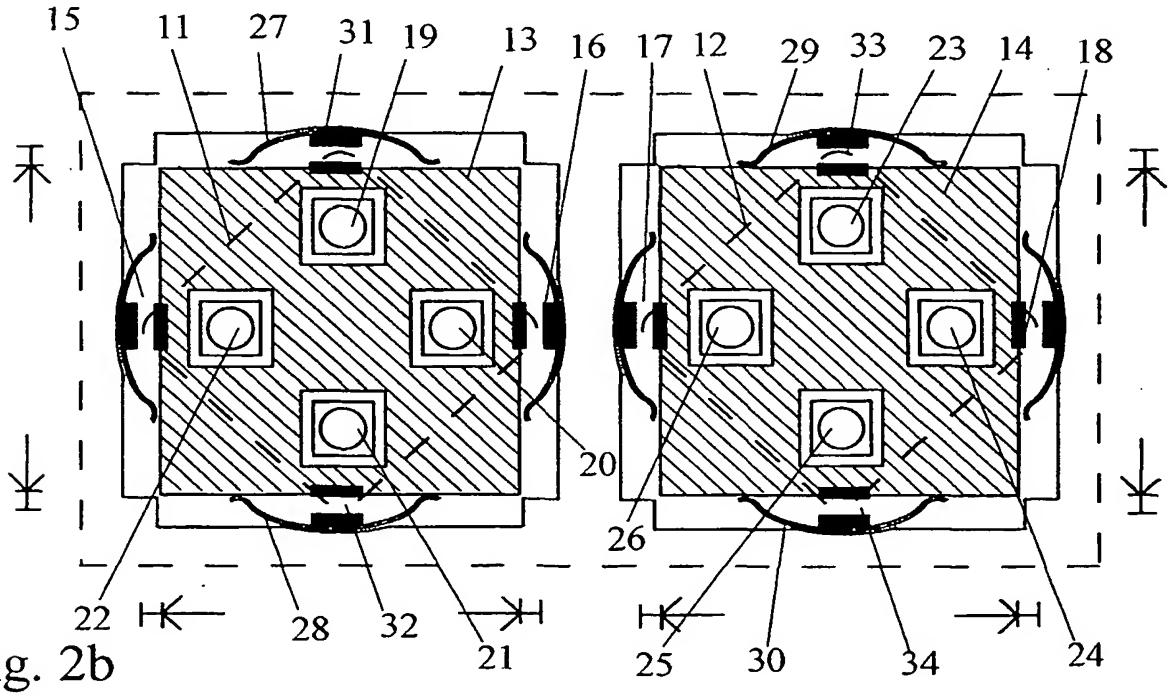


Fig. 2b

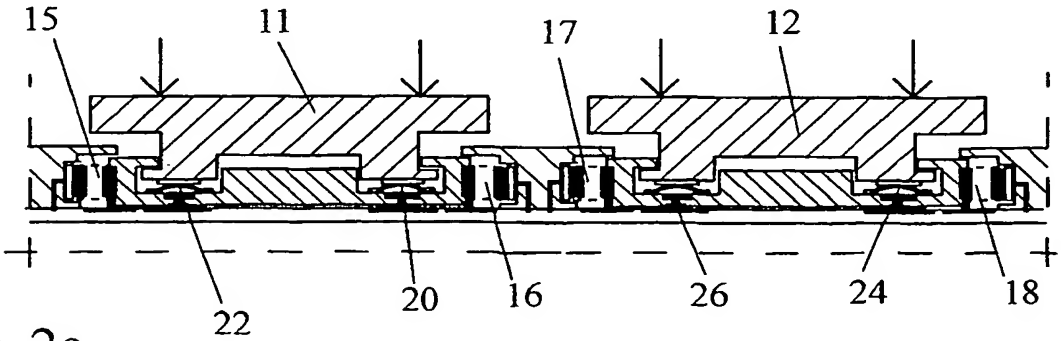


Fig. 2c

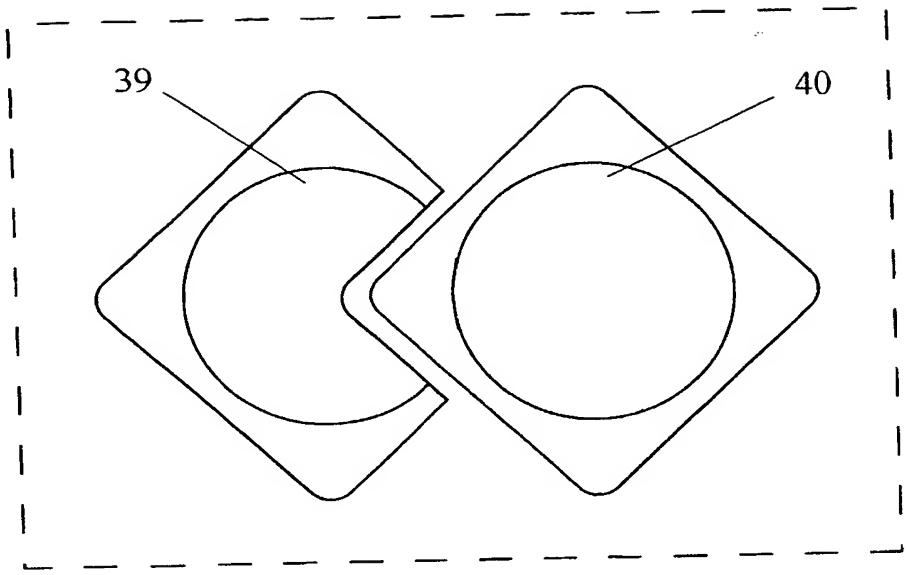

39
40

Fig. 3a

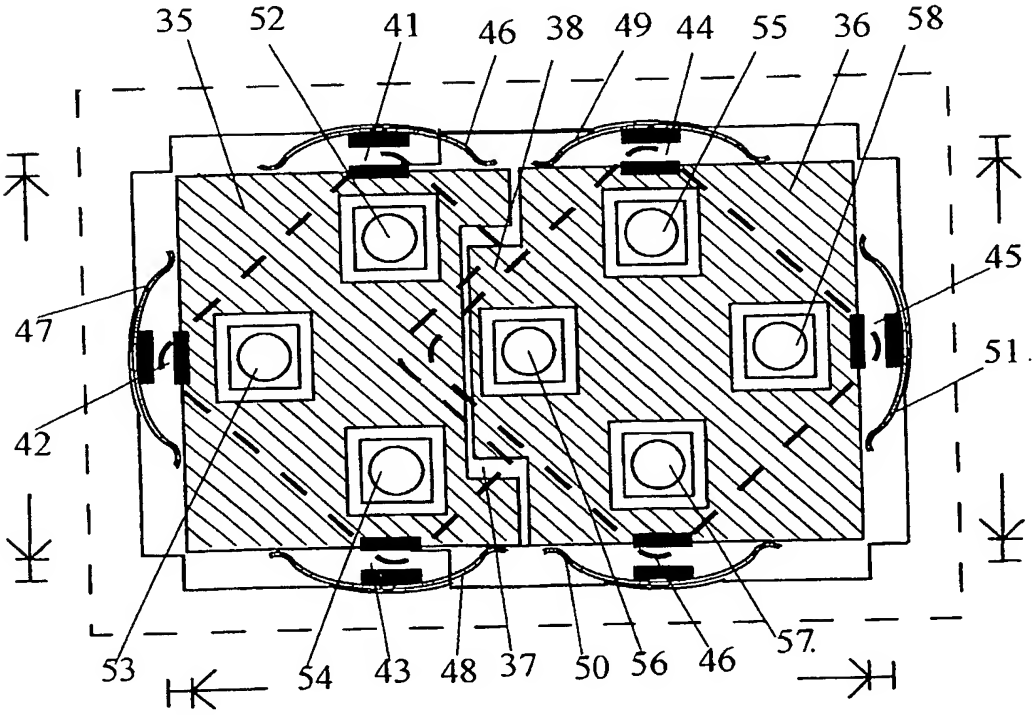

35
52
41
46
38
49
44
55
36
58
45
47
51
42
53
54
43
48
37
50
56
46
57

Fig. 3b

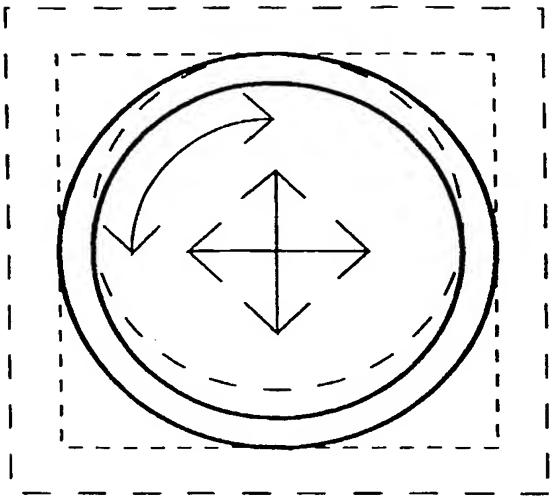


Fig. 4a

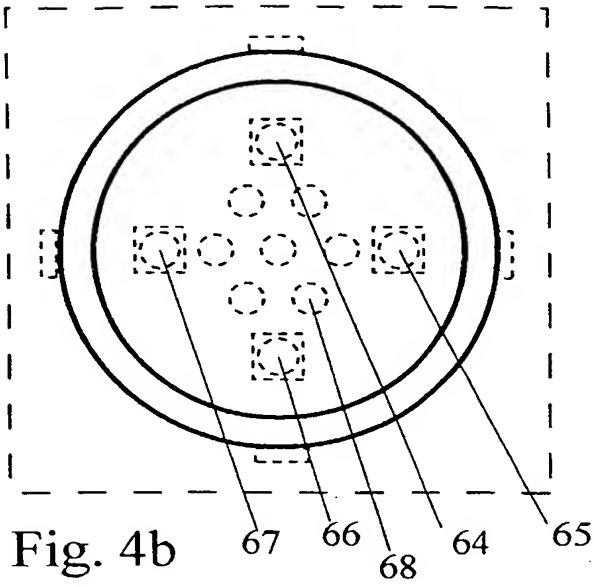


Fig. 4b

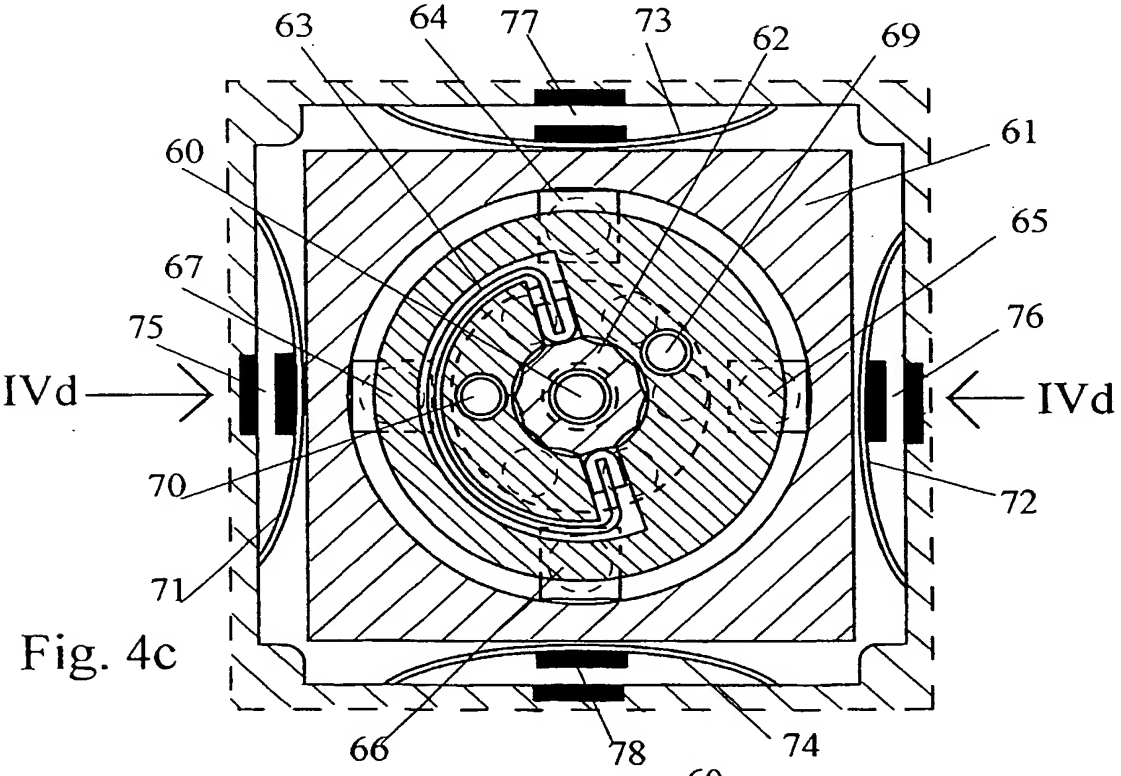


Fig. 4c

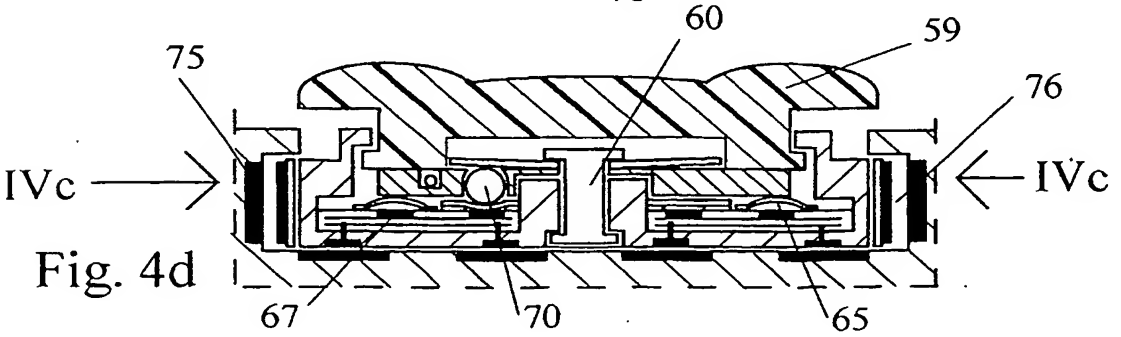


Fig. 4d

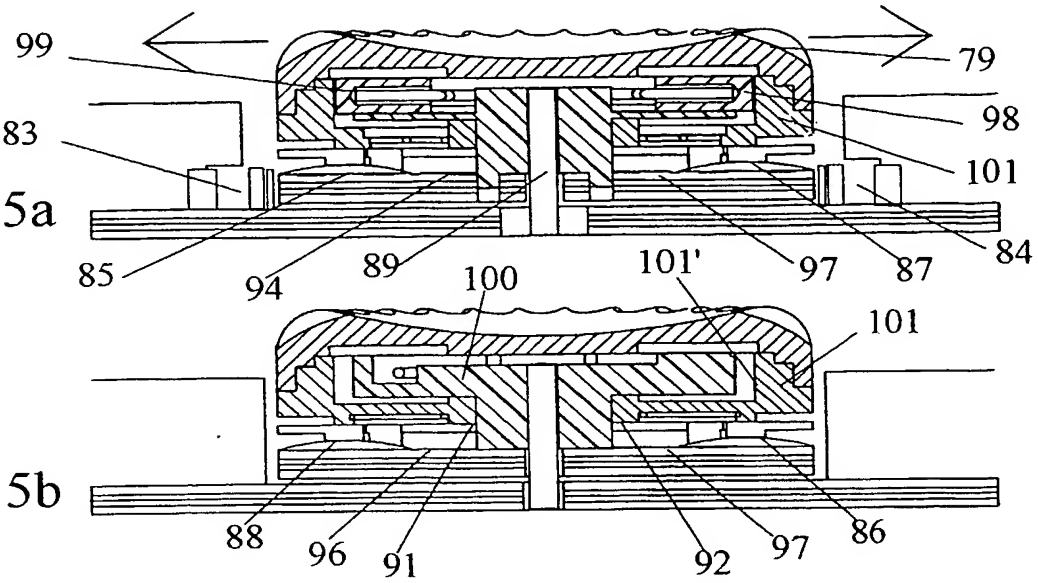


Fig. 5a

Fig. 5b

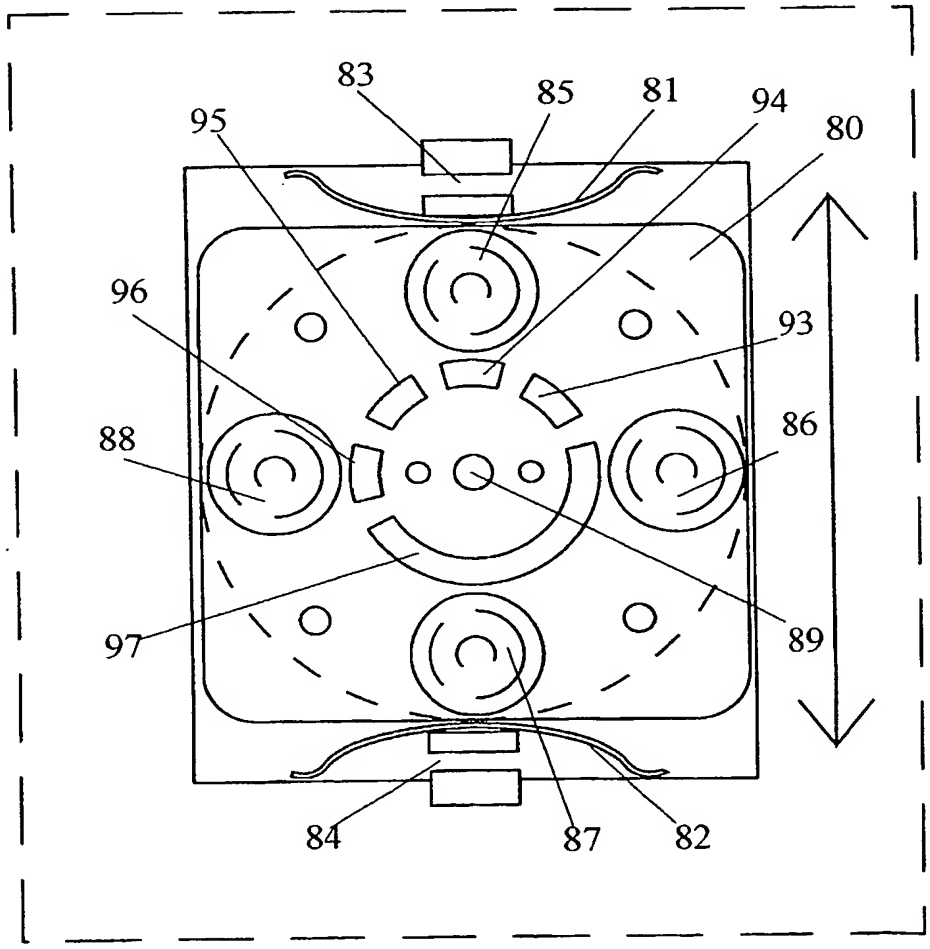


Fig. 5c

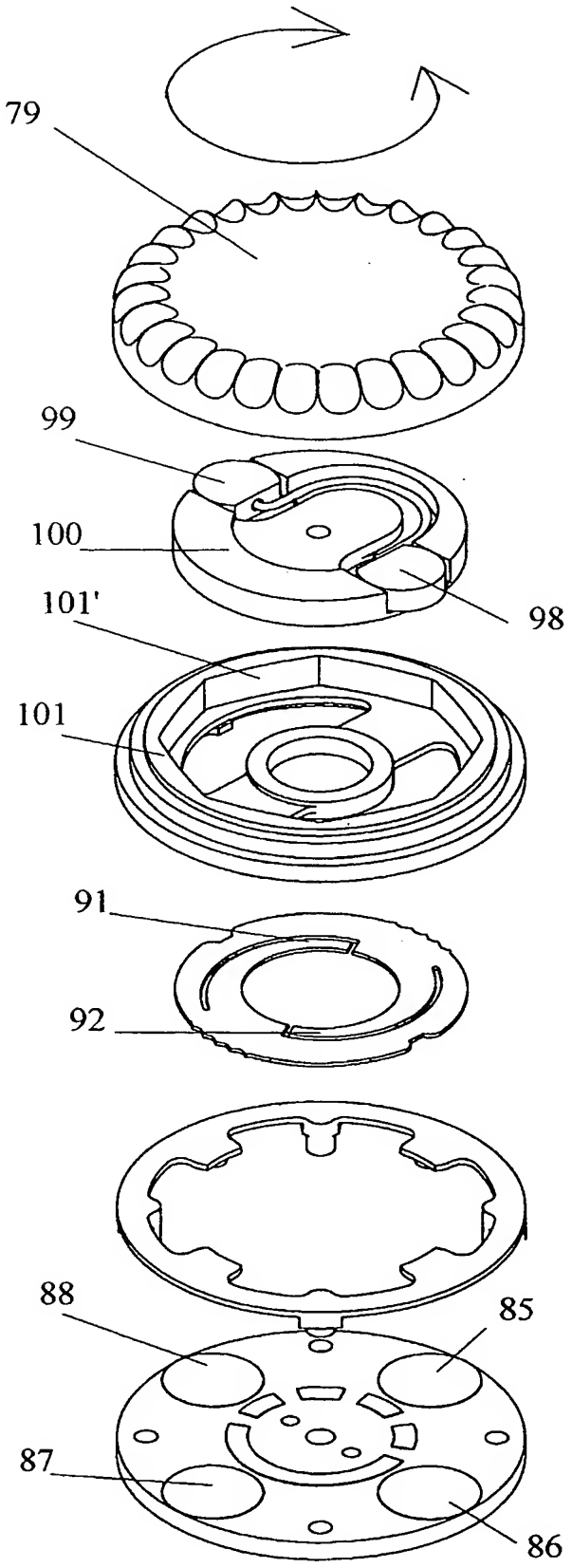


Fig. 5d

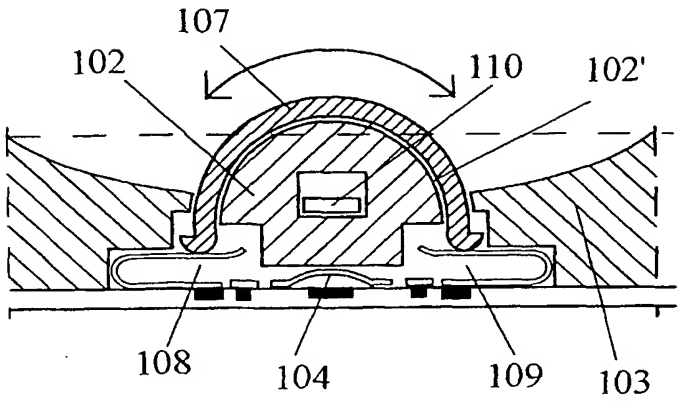


Fig. 6a

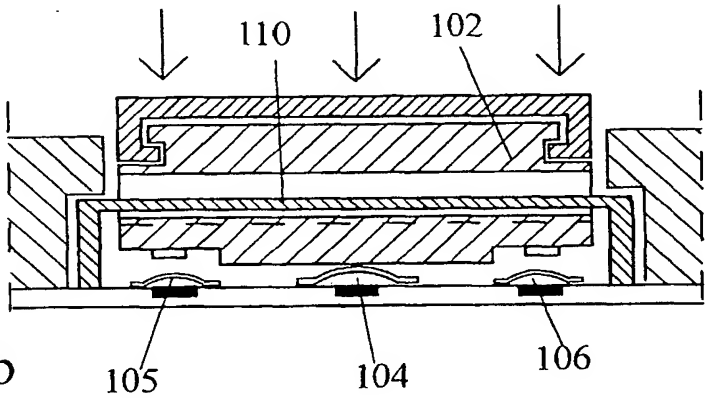


Fig. 6b

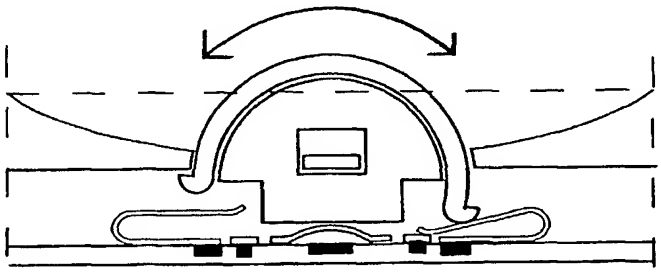


Fig. 6c

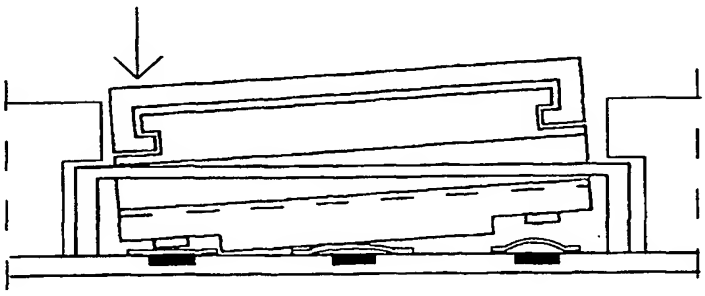


Fig. 6d

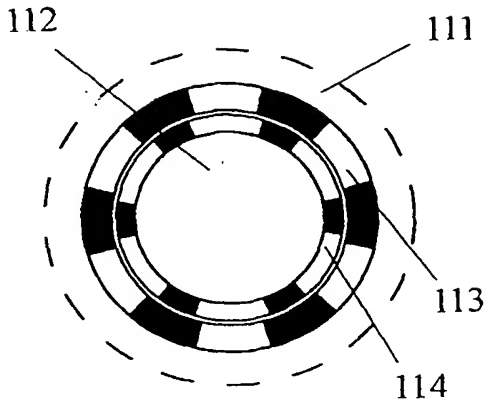


Fig. 7a

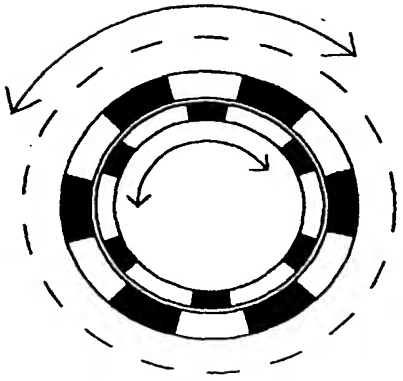


Fig. 7b

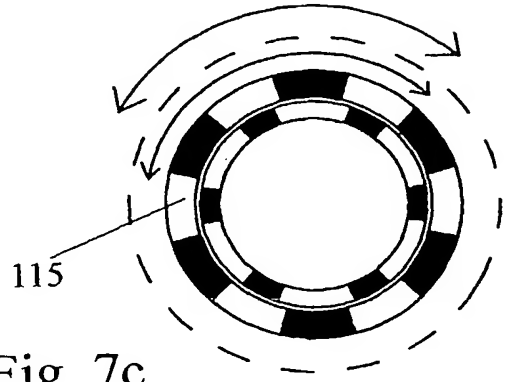


Fig. 7c

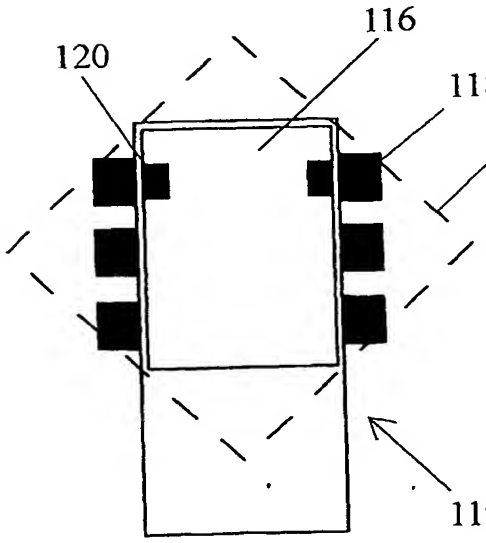


Fig. 8a

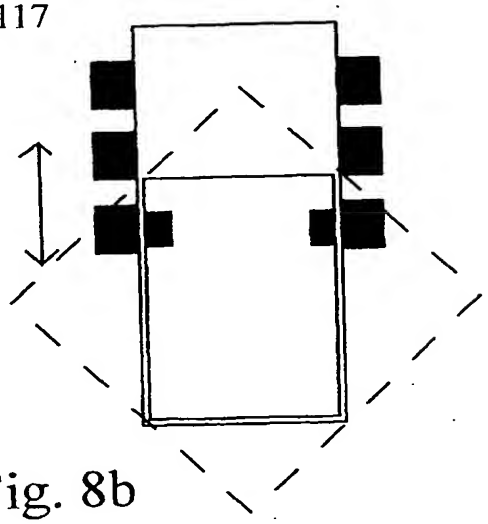


Fig. 8b

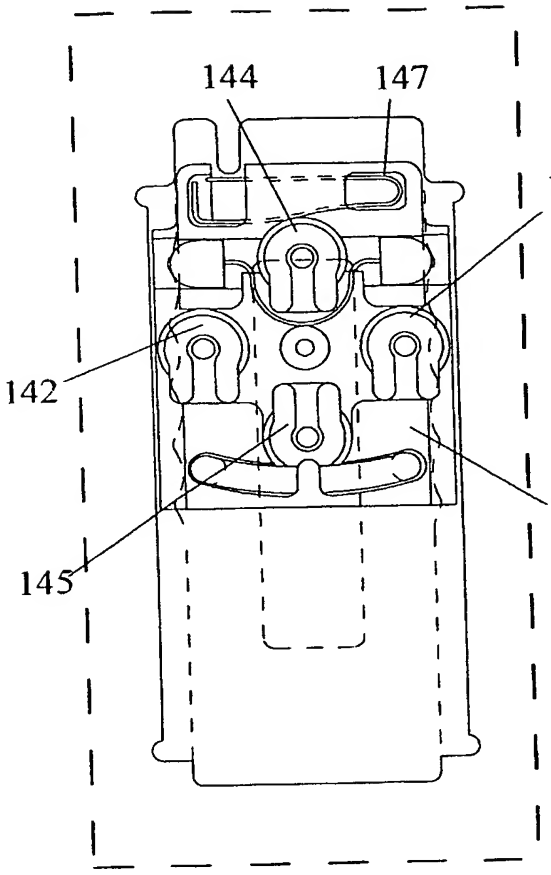


Fig. 9a

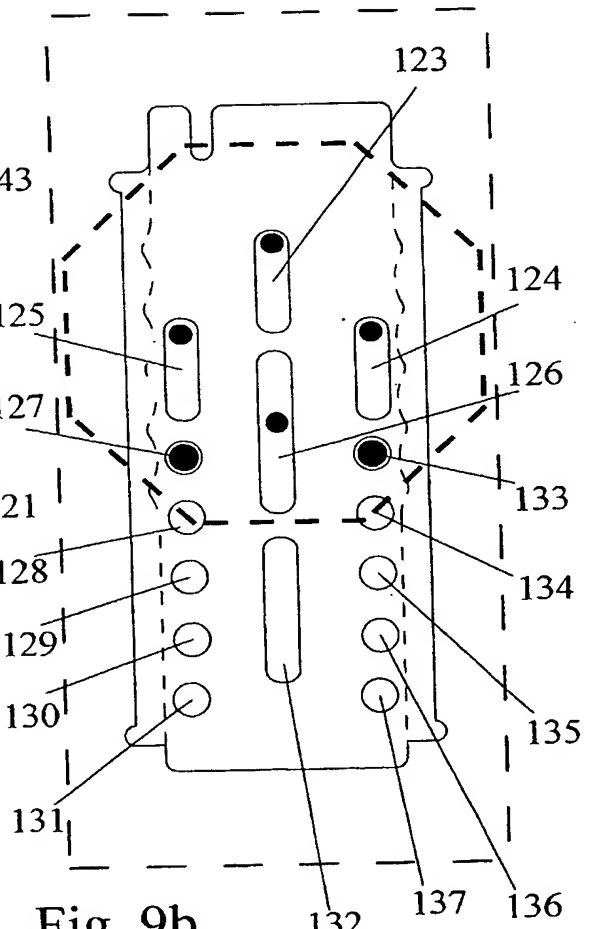


Fig. 9b

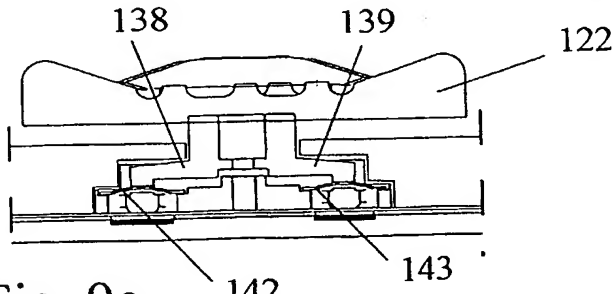


Fig. 9c

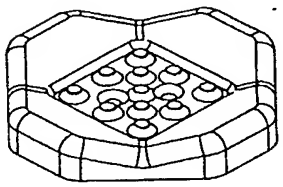


Fig. 9e

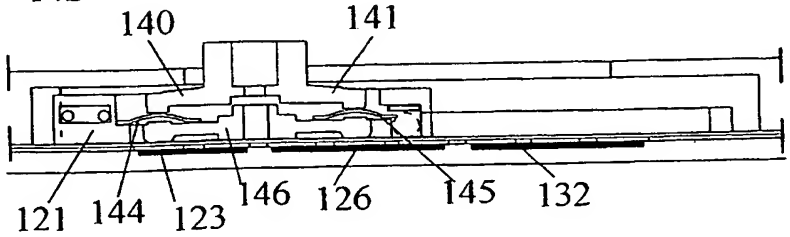


Fig. 9d

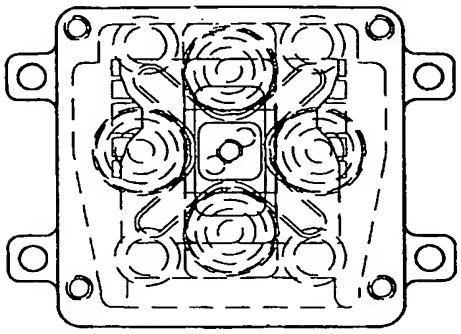


Fig. 10a

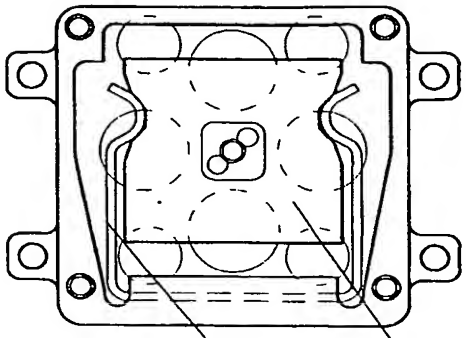


Fig. 10b

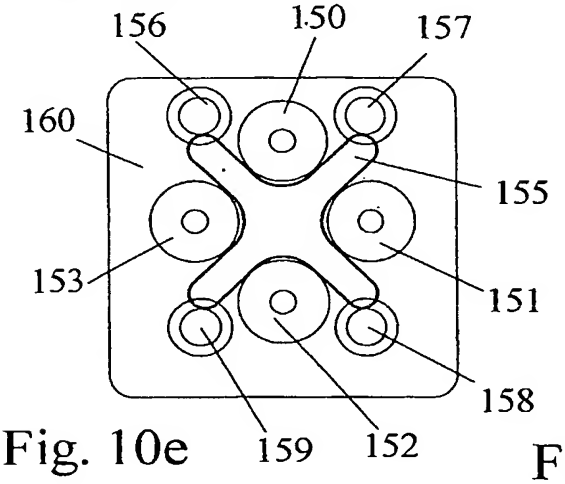


Fig. 10e

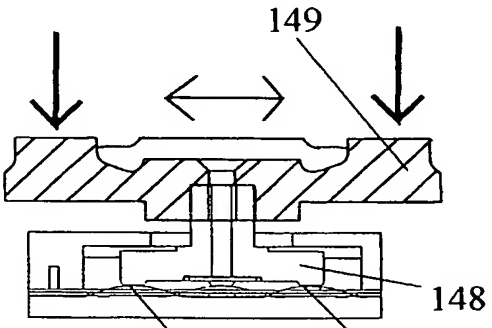


Fig. 10c

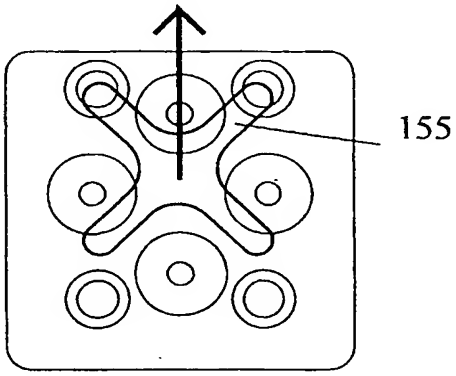


Fig. 10f

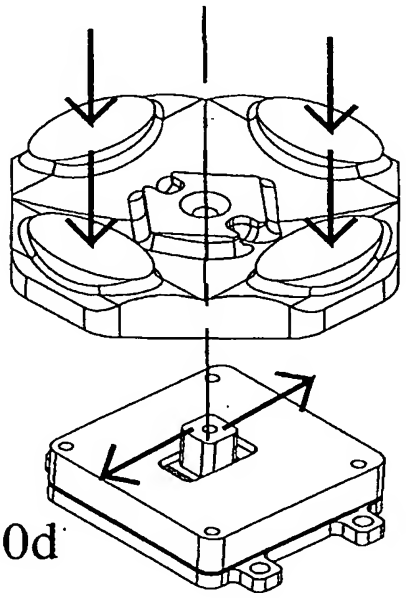


Fig. 10d

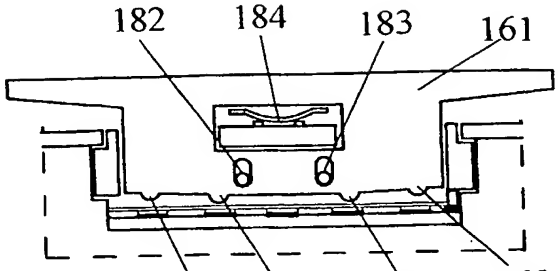


Fig. 11c

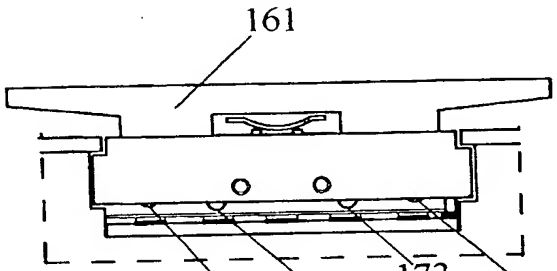


Fig. 11d

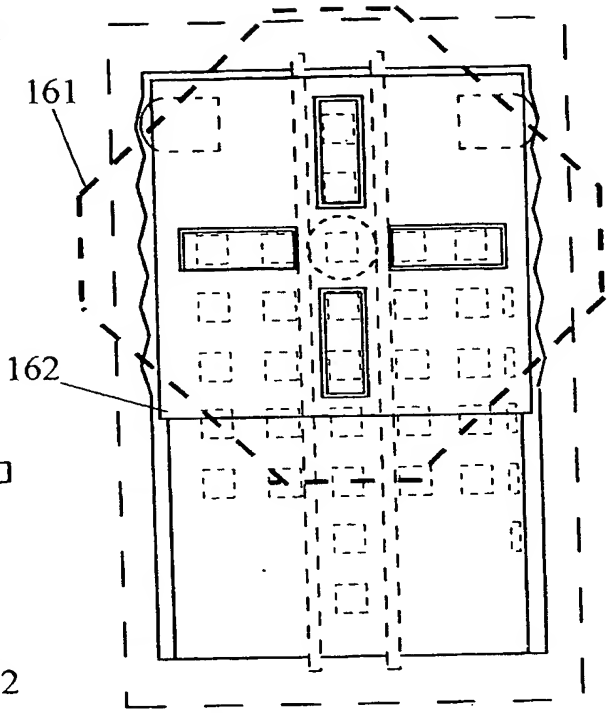


Fig. 11a

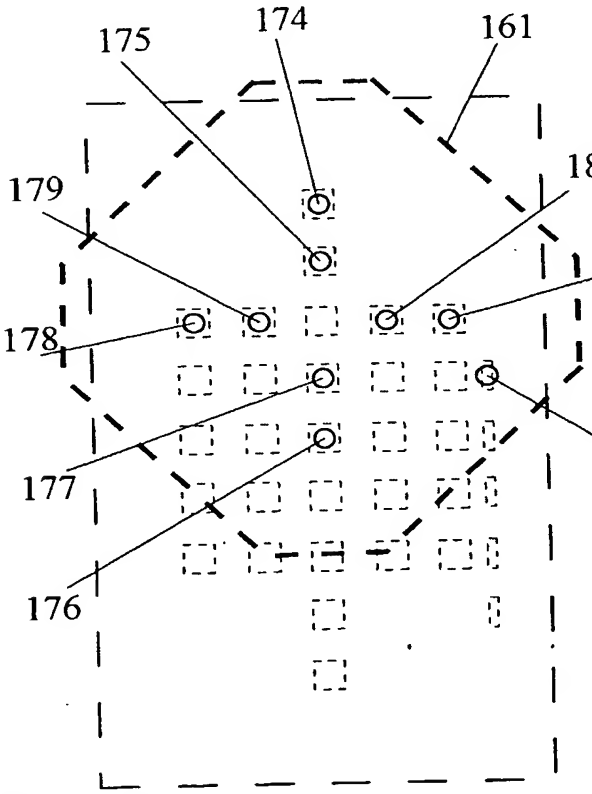


Fig. 11e

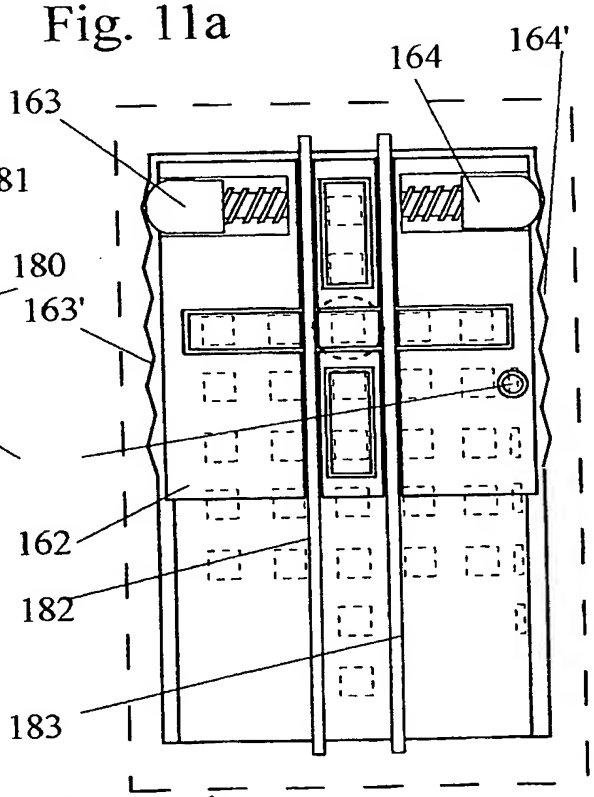


Fig. 11b

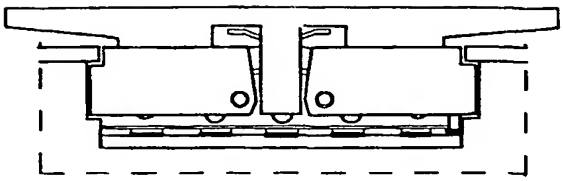


Fig. 11g

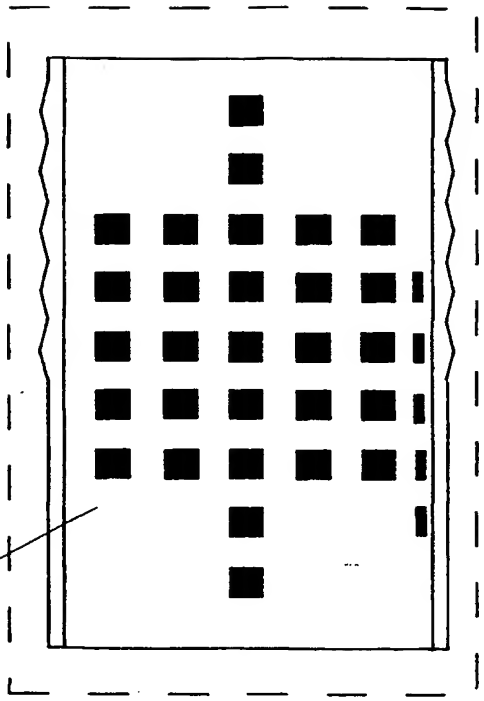


Fig. 11f

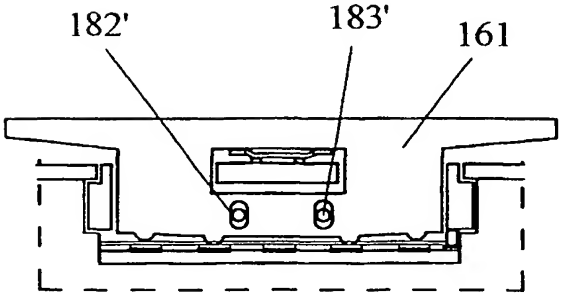


Fig. 11h

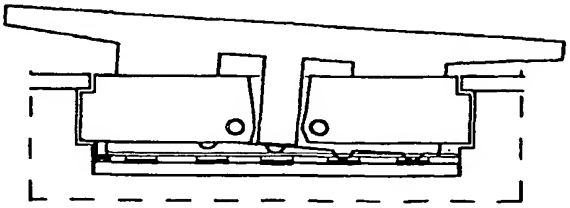


Fig. 11j

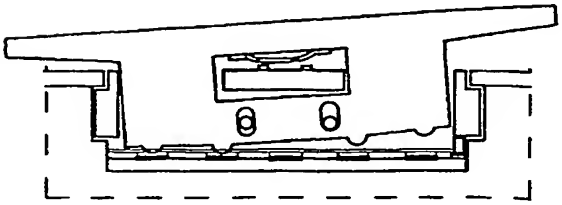


Fig. 11i

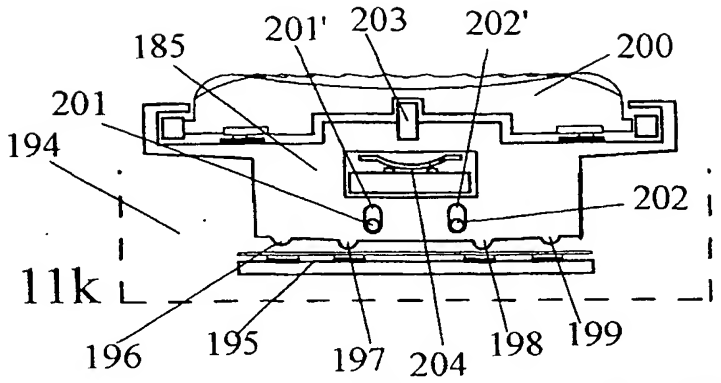


Fig. 11k

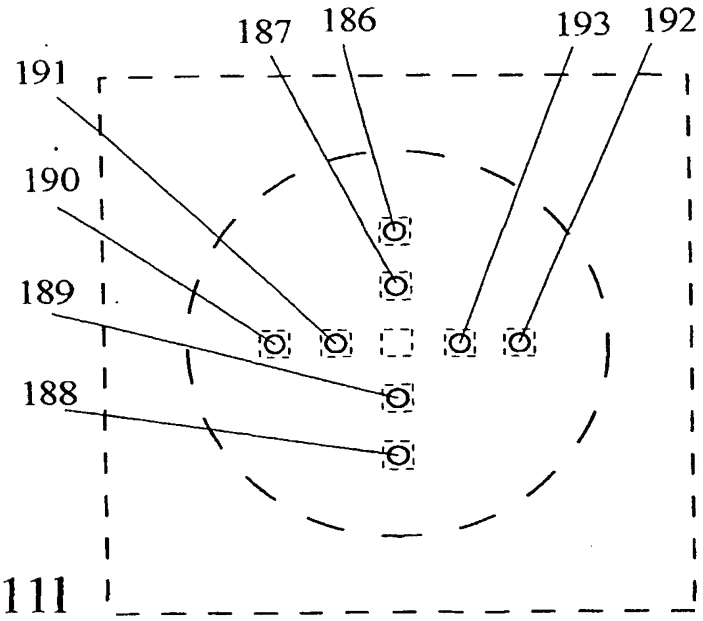


Fig. 11l

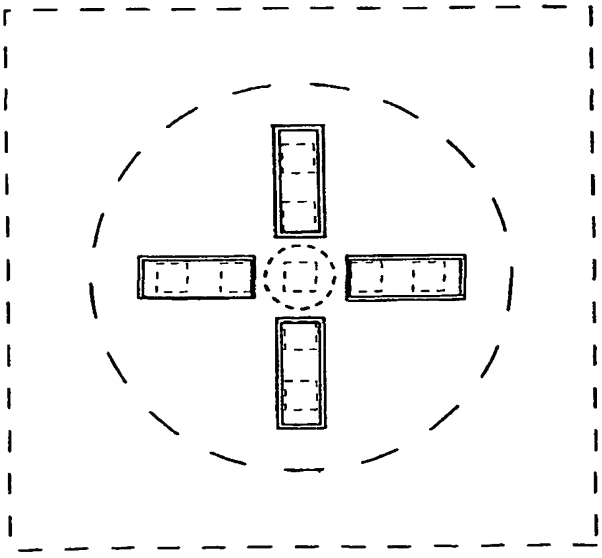


Fig. 11m

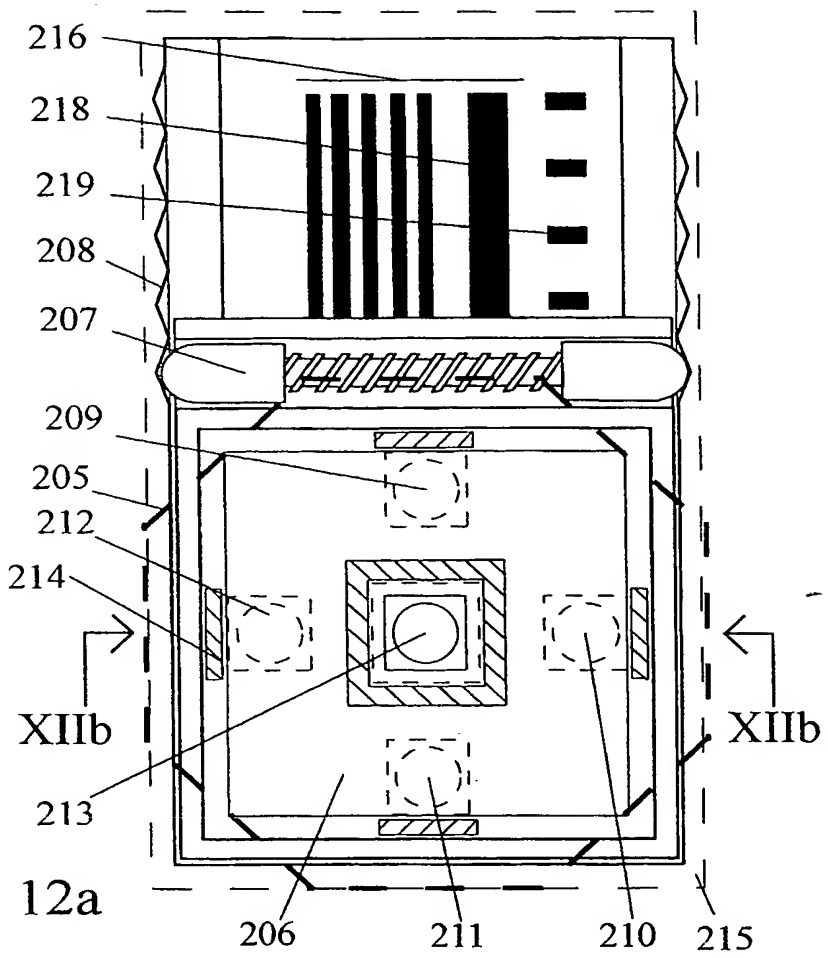


Fig. 12a

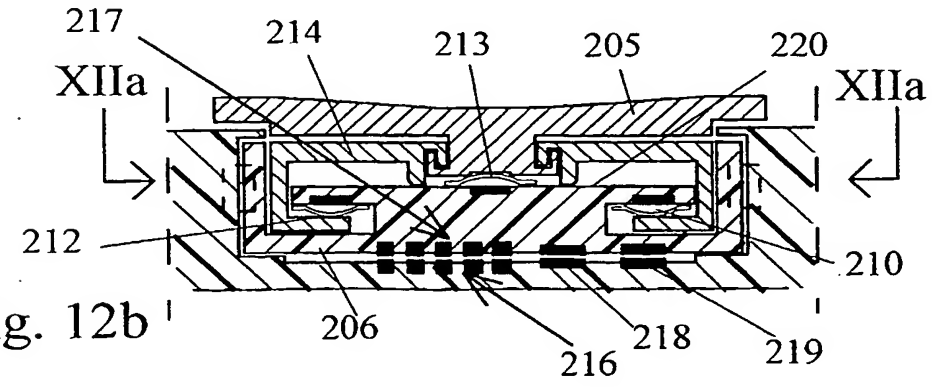


Fig. 12b

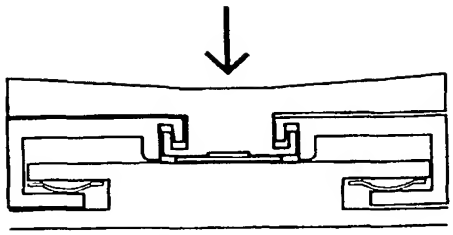


Fig. 12c

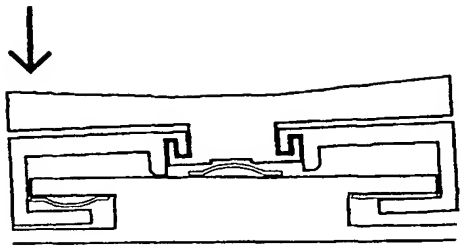


Fig. 12d

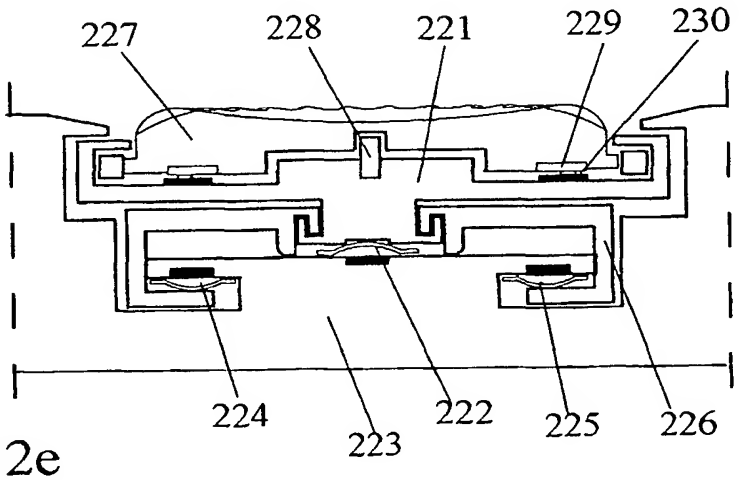


Fig. 12e

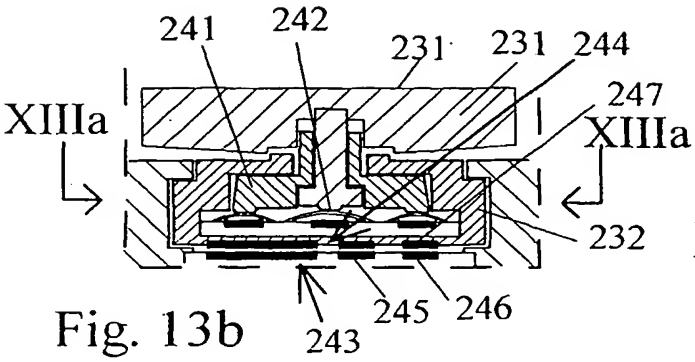


Fig. 13b

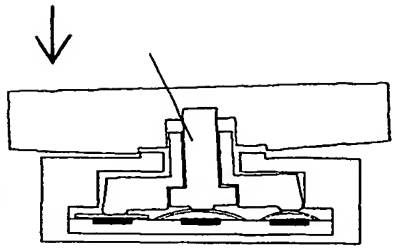


Fig. 13c

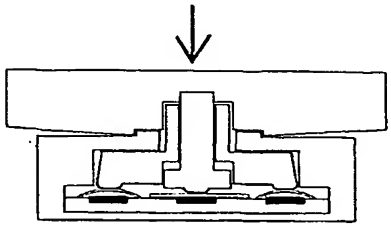


Fig. 13d

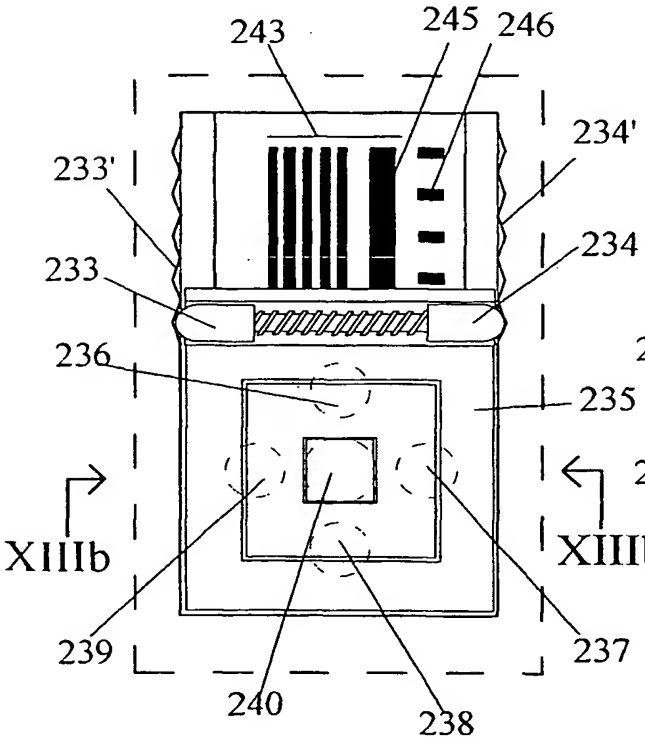


Fig. 13a

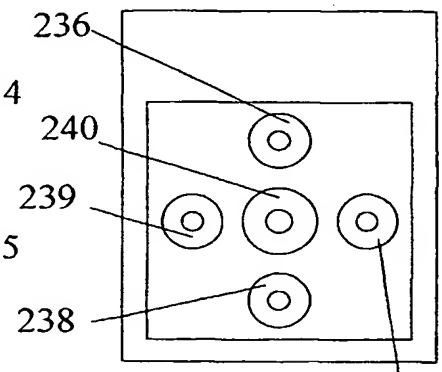


Fig. 13e

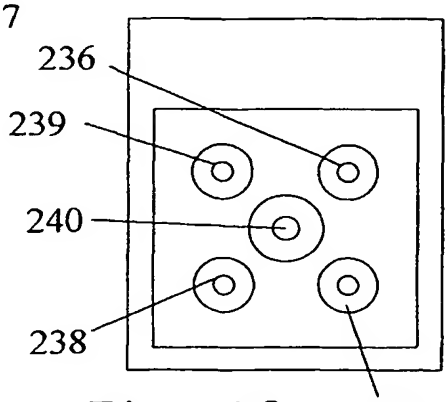


Fig. 13f

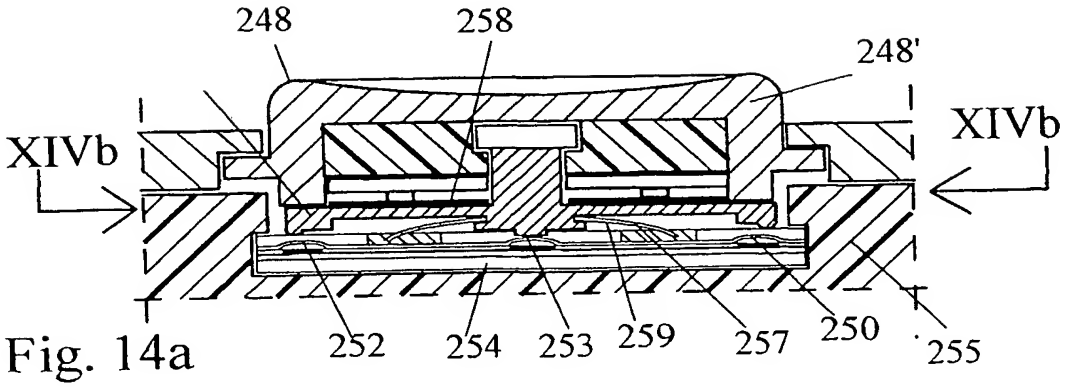


Fig. 14a

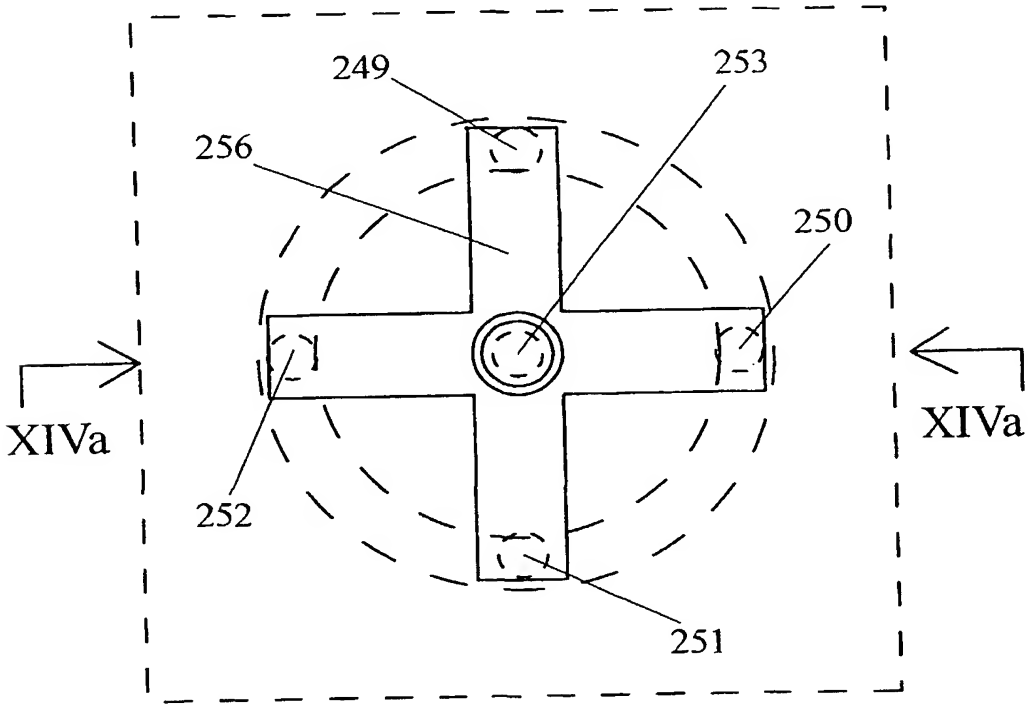


Fig. 14b

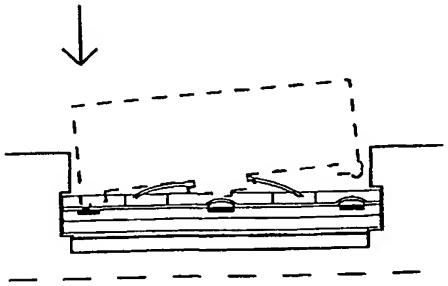


Fig. 14c

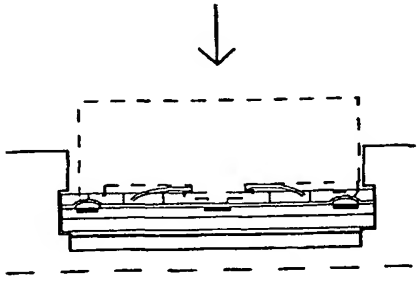


Fig. 14d

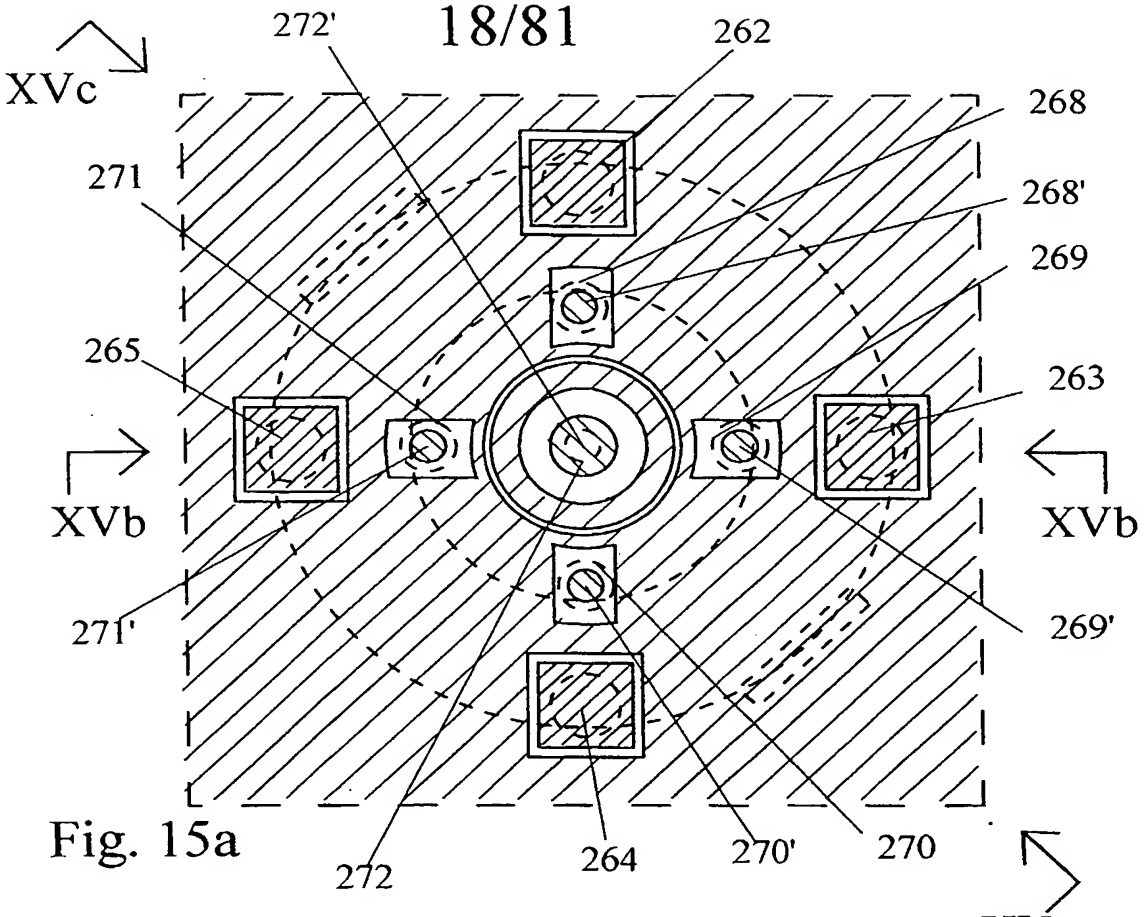


Fig. 15a

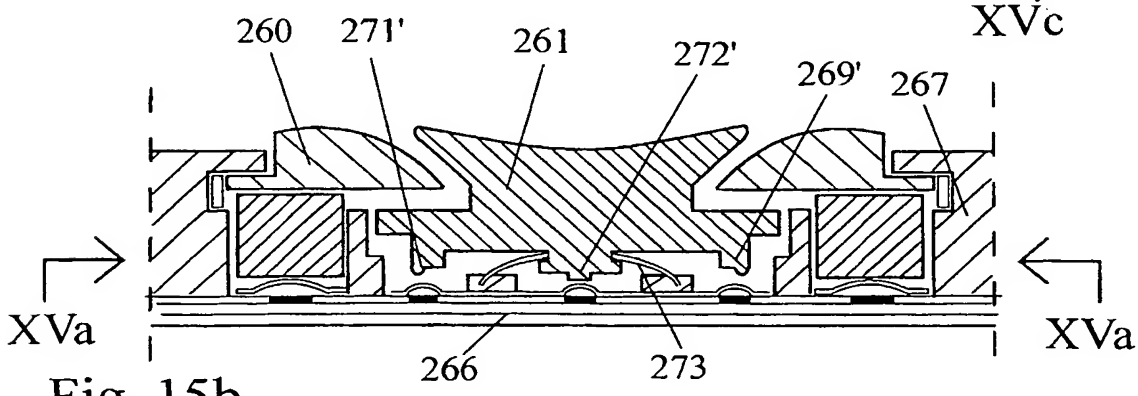


Fig. 15b

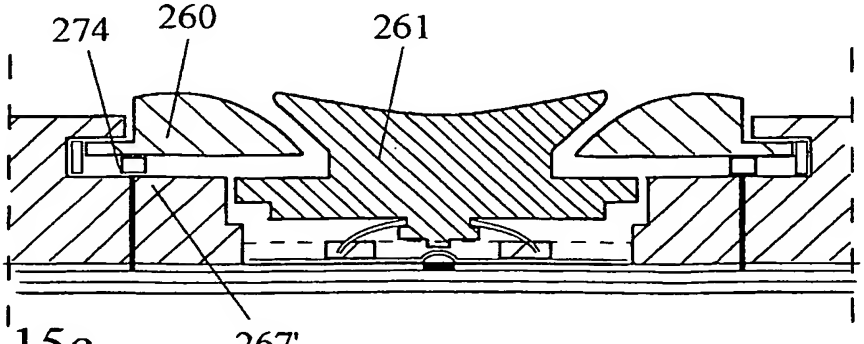


Fig. 15c

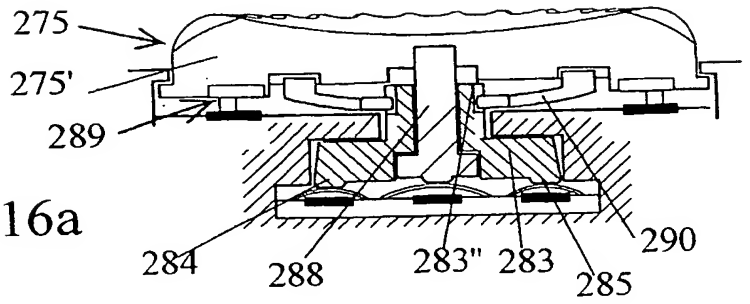


Fig. 16a

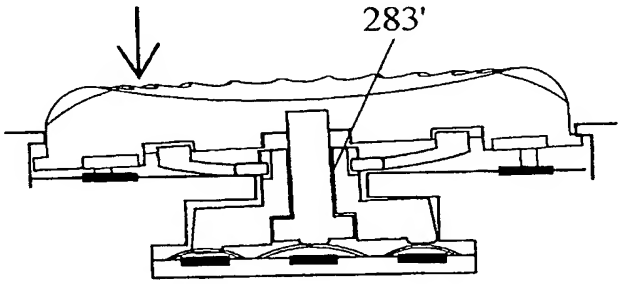


Fig. 16b

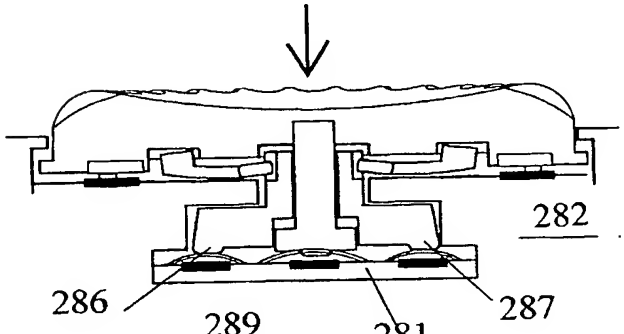


Fig. 16c

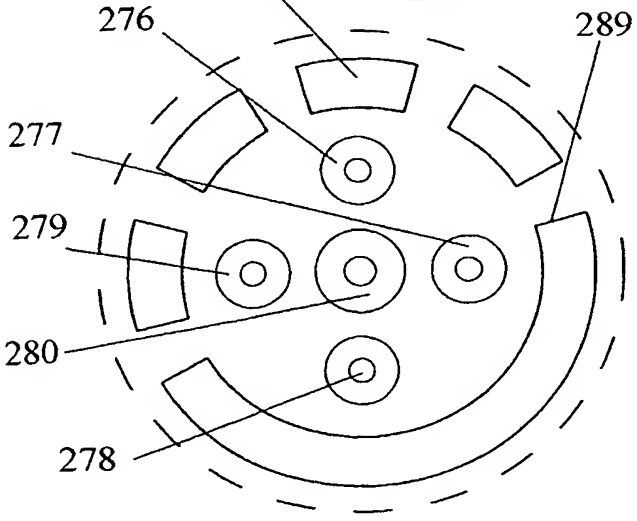


Fig. 16d

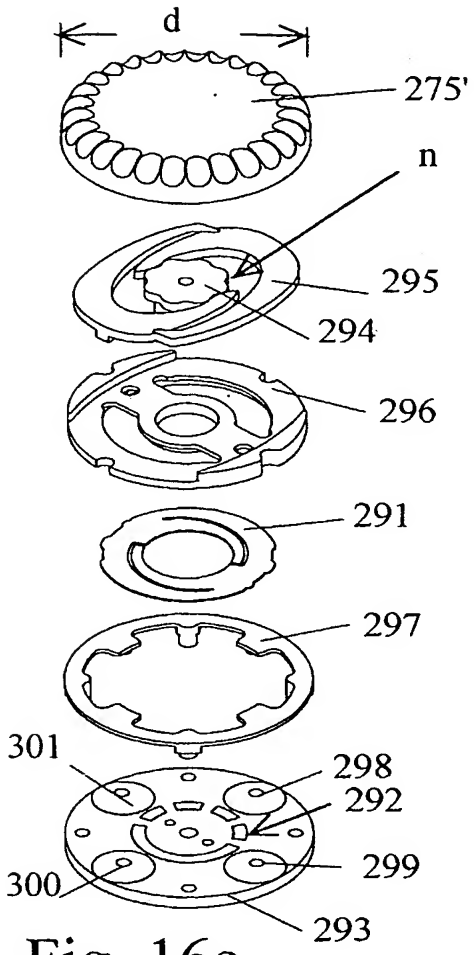


Fig. 16e

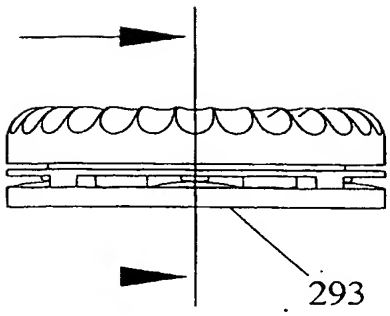


Fig. 16f

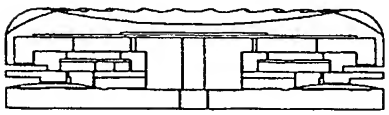


Fig. 16g

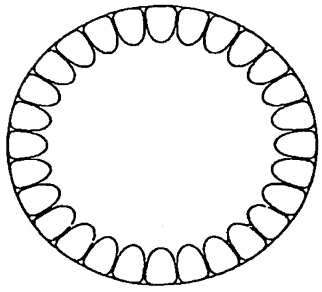


Fig. 16h

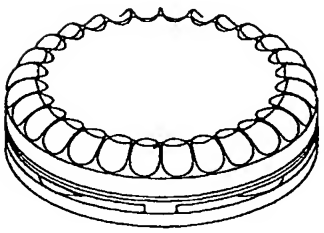


Fig. 16i

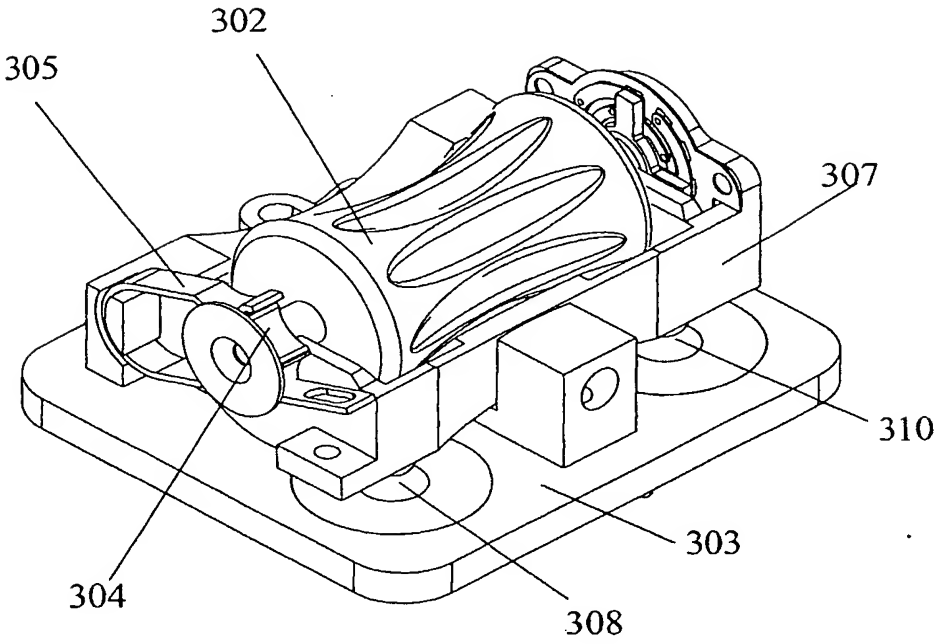


Fig.17a

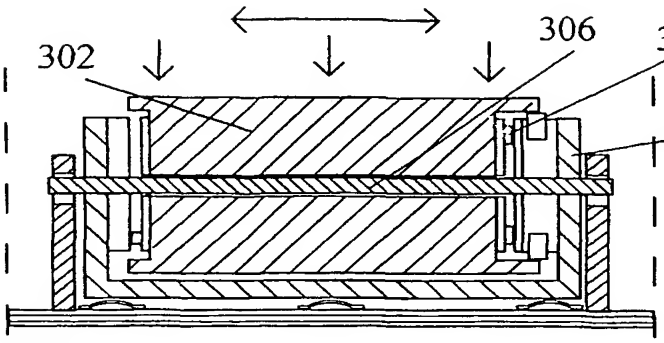


Fig. 17b

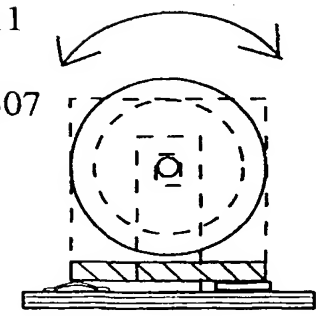


Fig. 17c

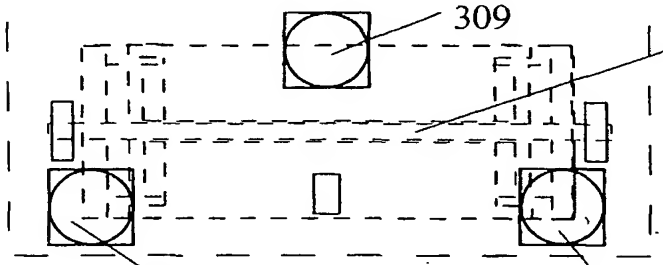


Fig. 17d

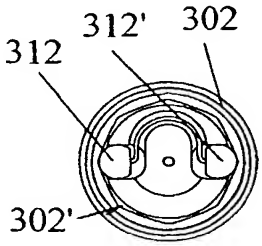


Fig. 17e

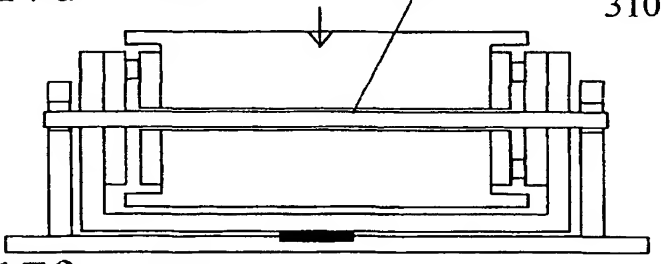


Fig. 17f

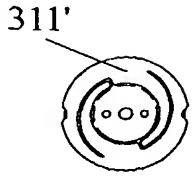


Fig. 17i

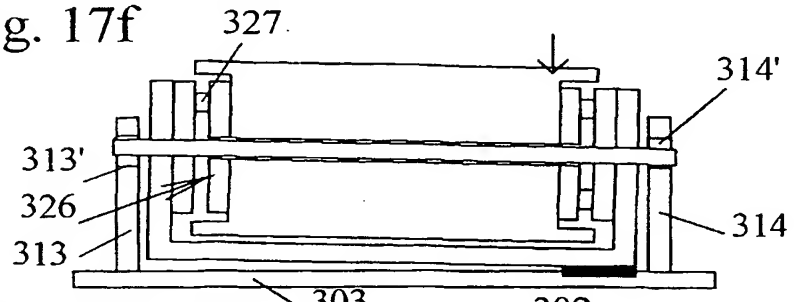


Fig. 17g

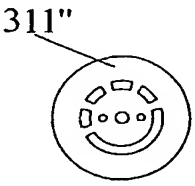


Fig. 17j

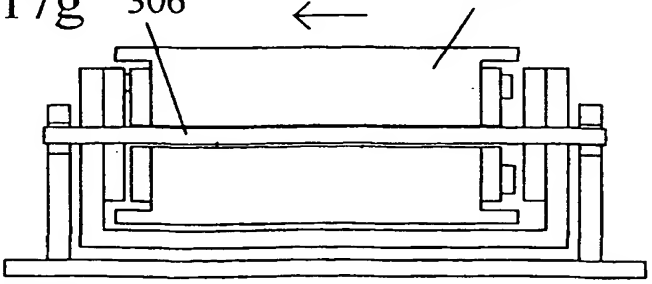


Fig. 17h

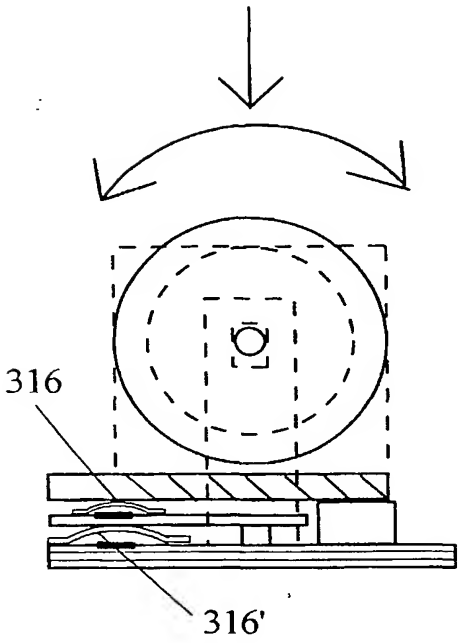


Fig.17m

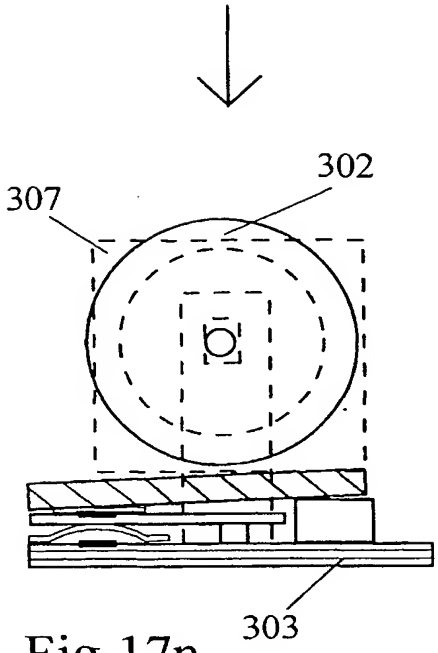


Fig.17n

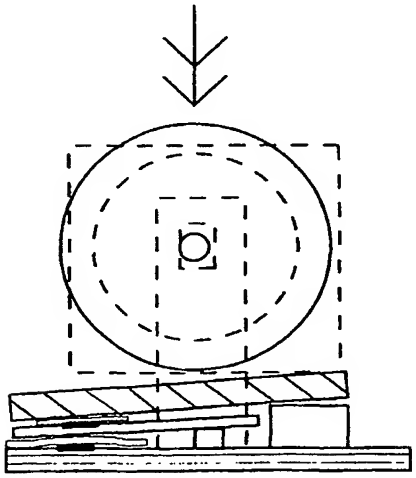


Fig.17o

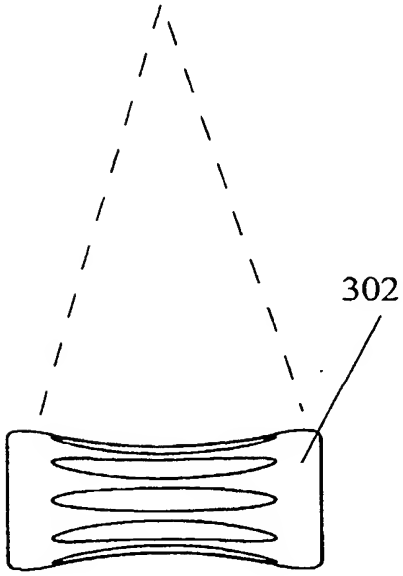


Fig.17k

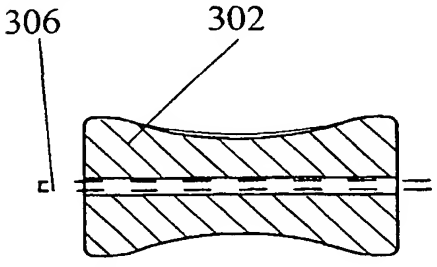


Fig.17l

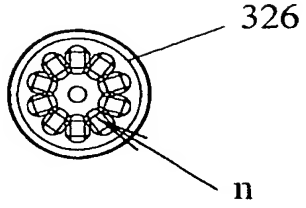


Fig. 18b

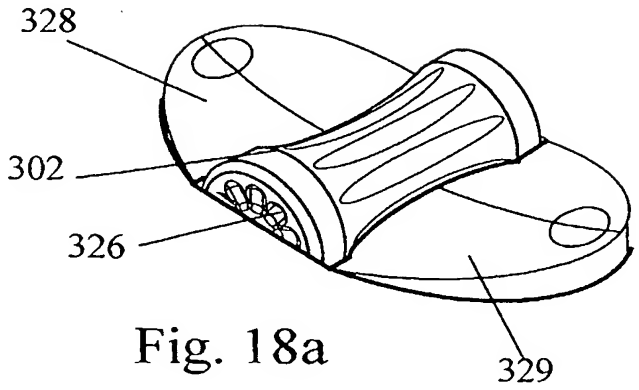


Fig. 18a

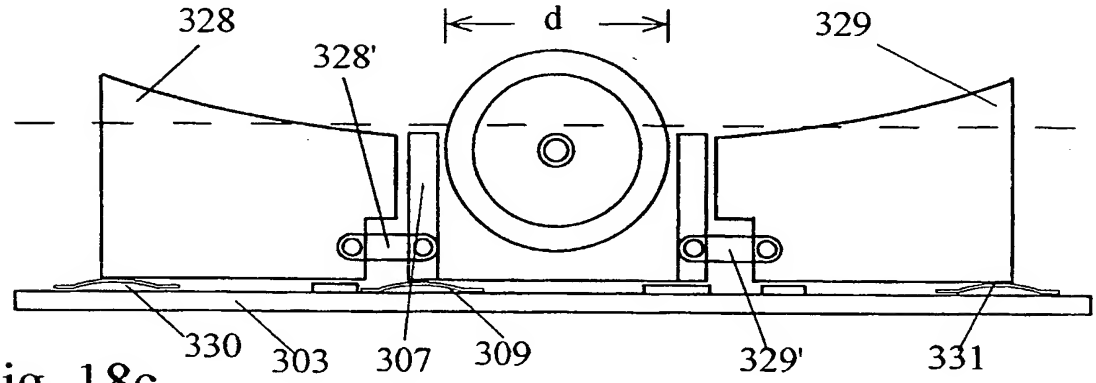


Fig. 18c

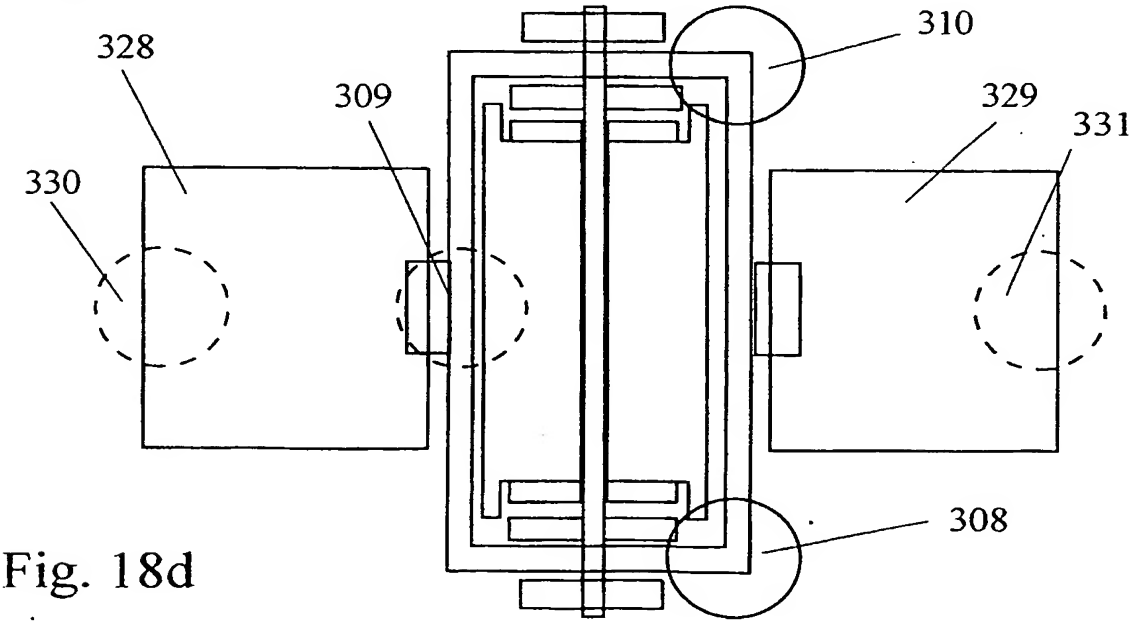


Fig. 18d

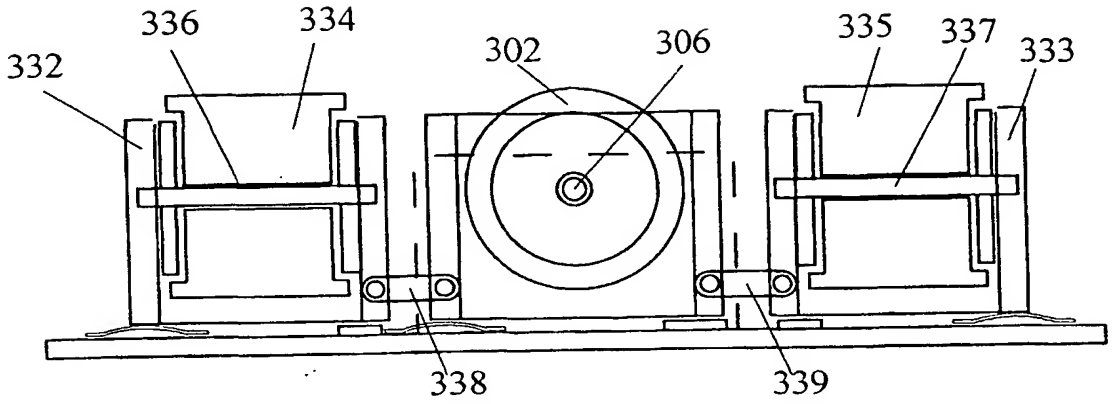


Fig. 19a

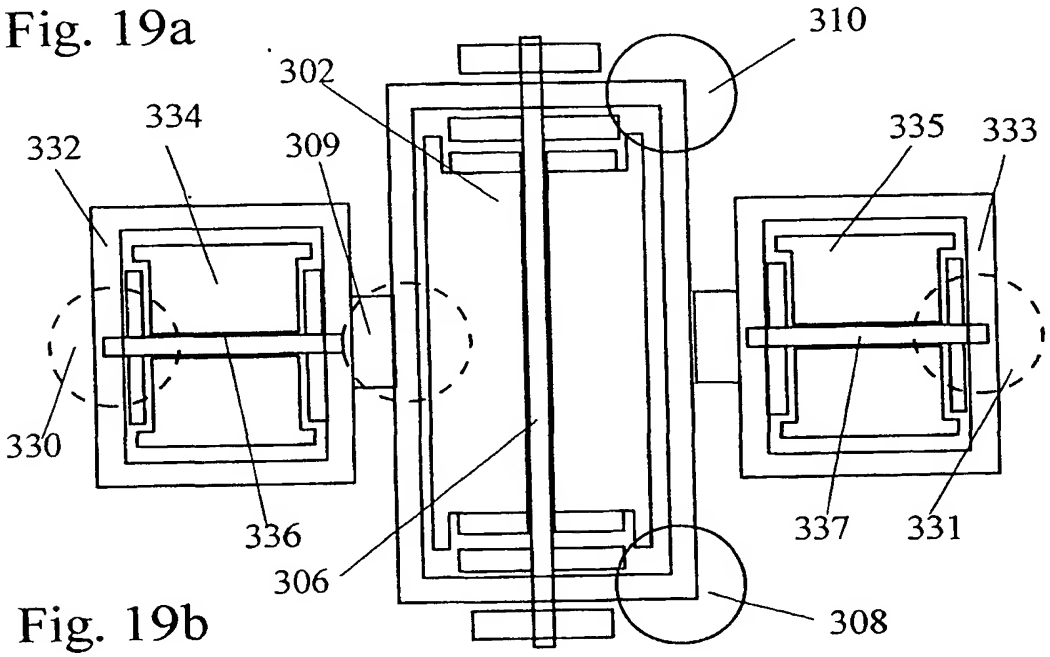


Fig. 19b

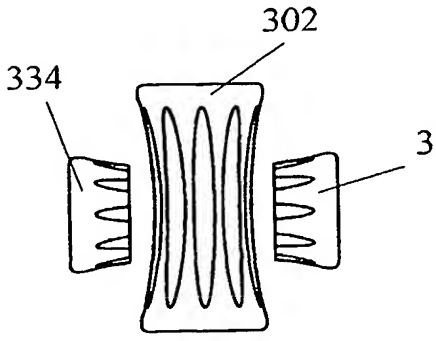


Fig. 19d

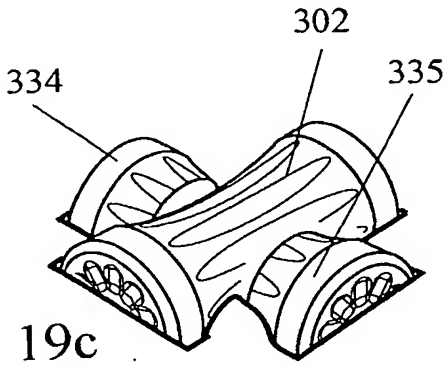


Fig. 19c

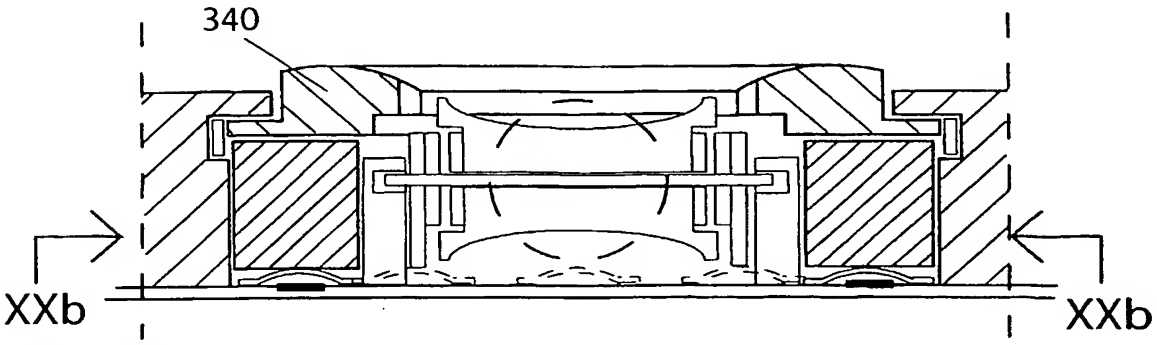


Fig. 20a

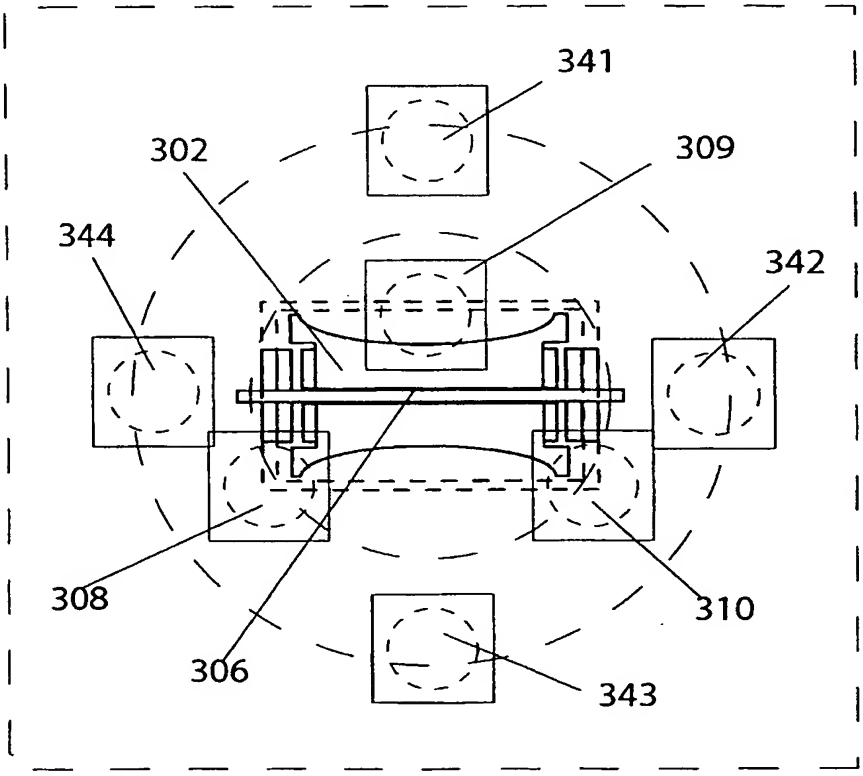


Fig. 20b

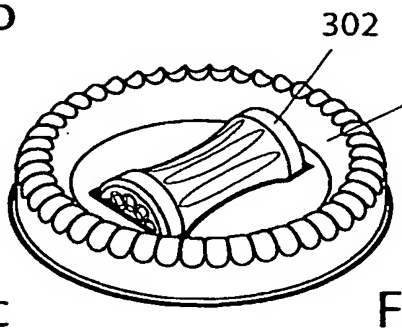


Fig. 20c

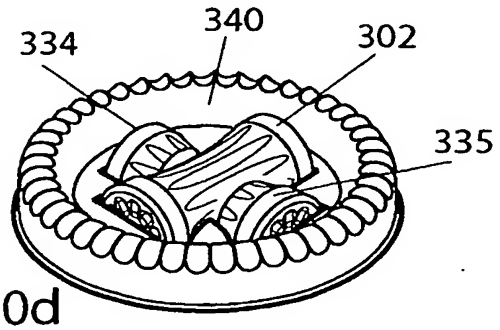


Fig. 20d

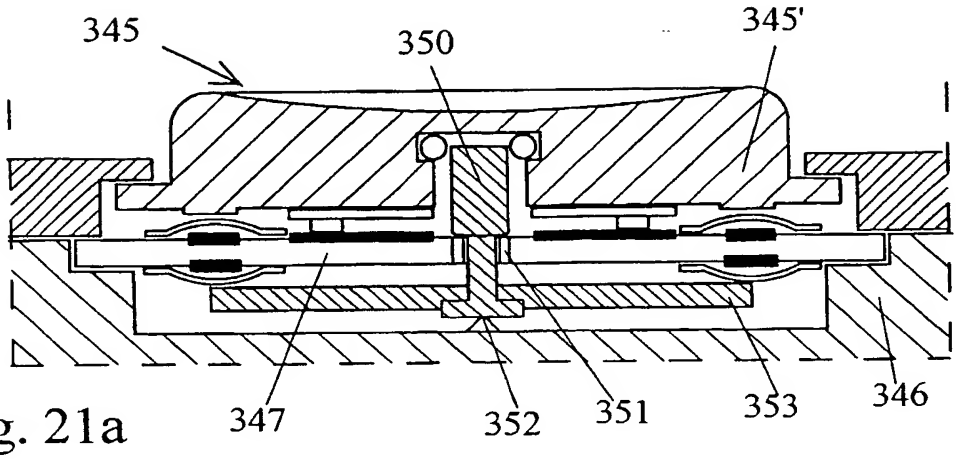


Fig. 21a

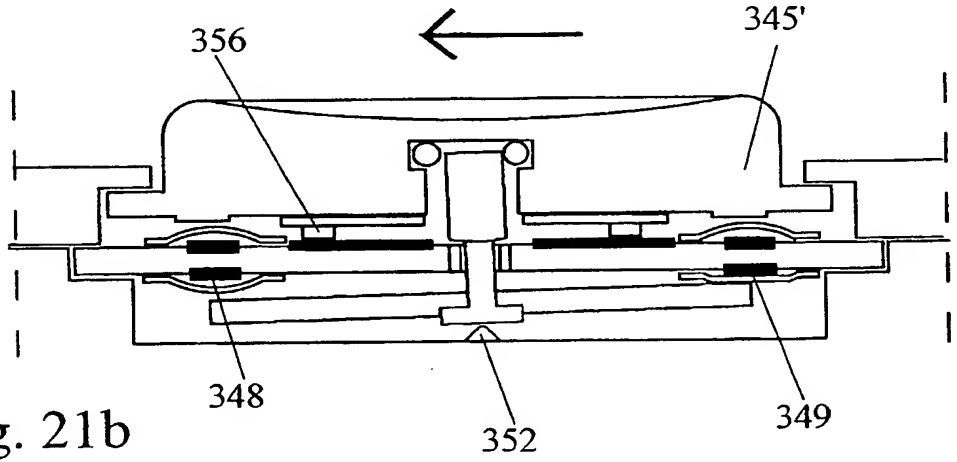


Fig. 21b

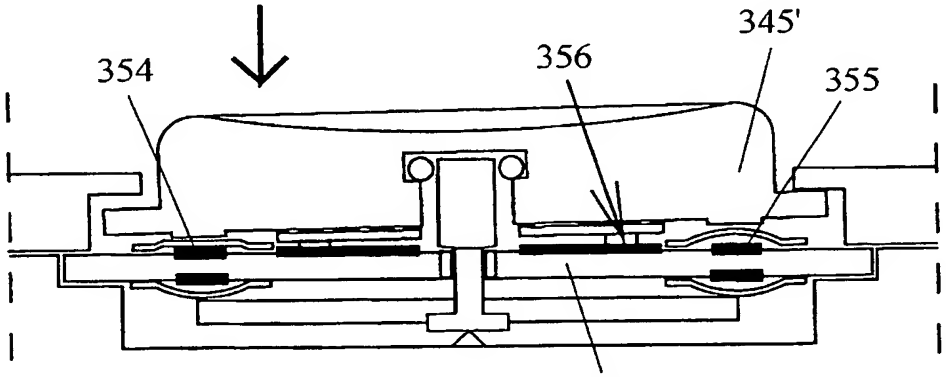


Fig. 21c

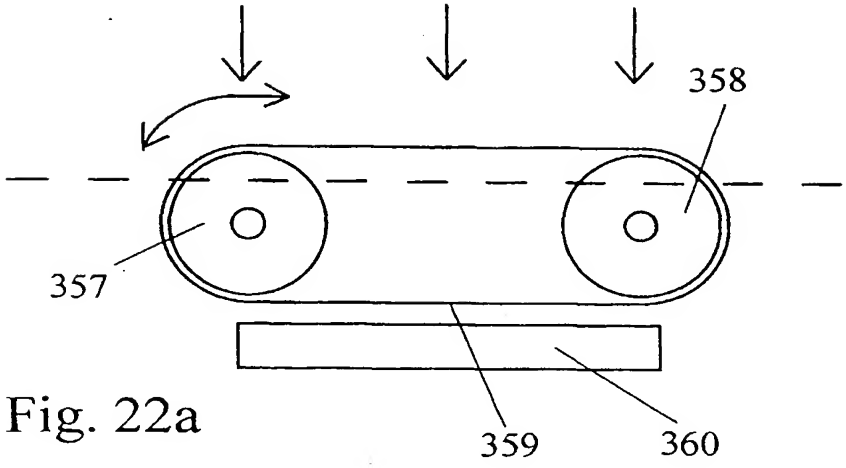


Fig. 22a

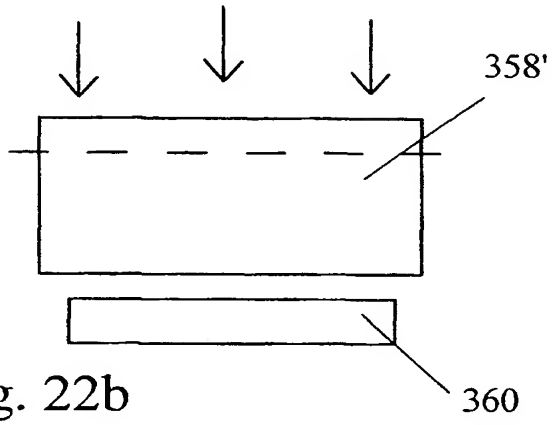


Fig. 22b

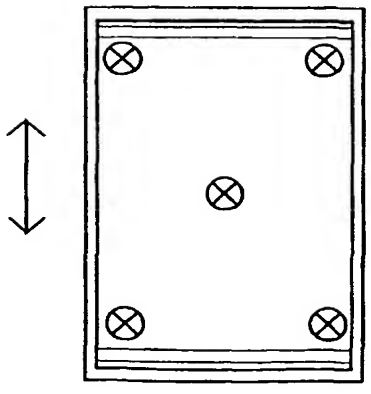


Fig. 22c

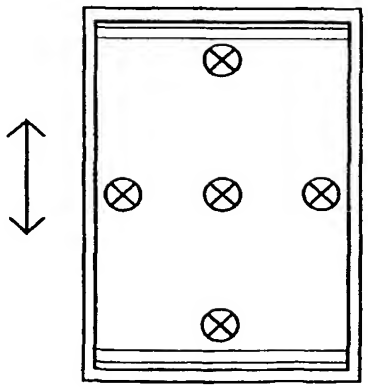


Fig. 22d

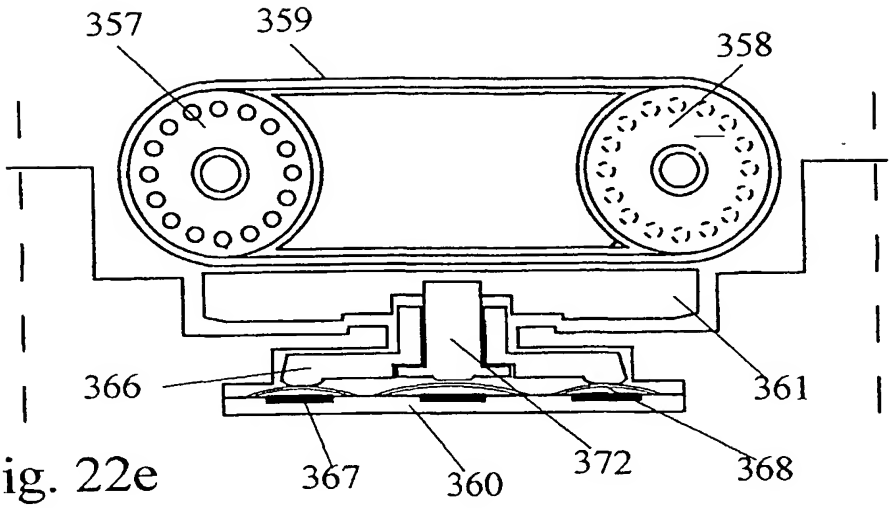


Fig. 22e

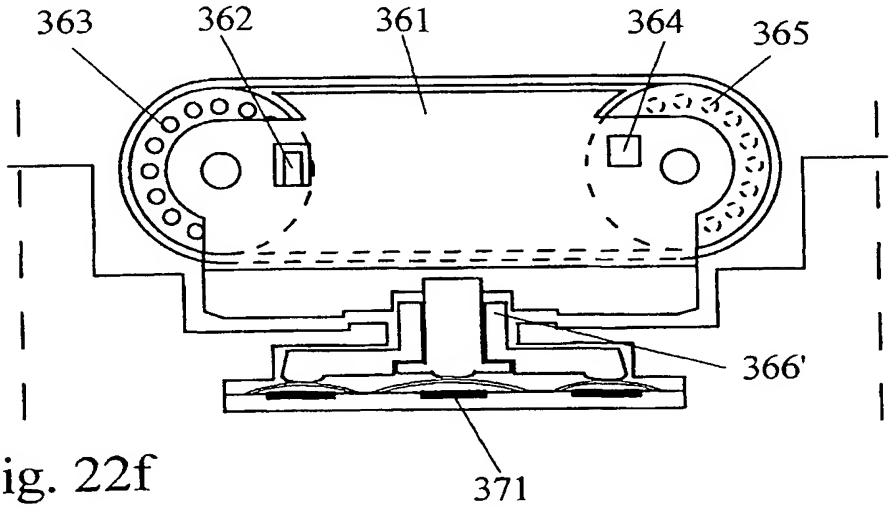


Fig. 22f

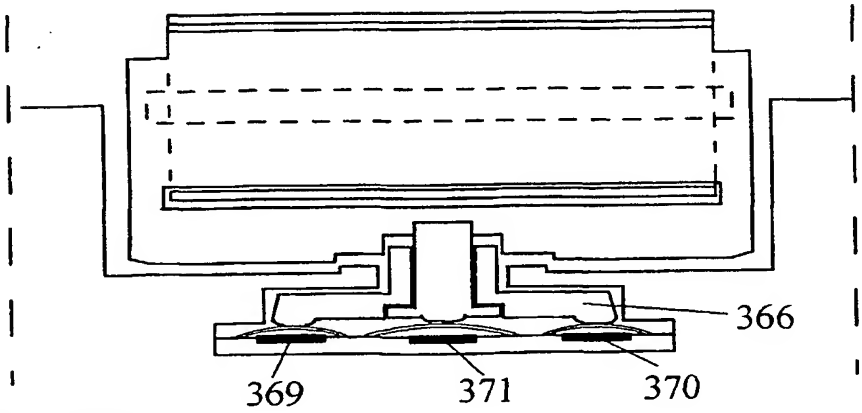


Fig. 22g

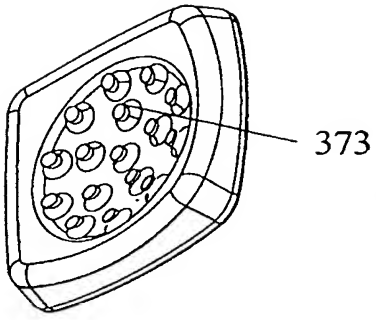


Fig. 23a

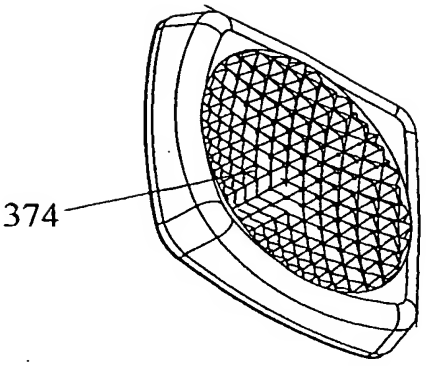


Fig. 24a

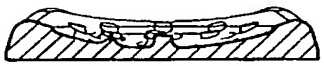


Fig. 23b

Fig. 24b

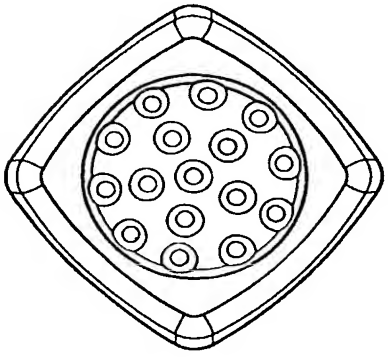


Fig. 23c

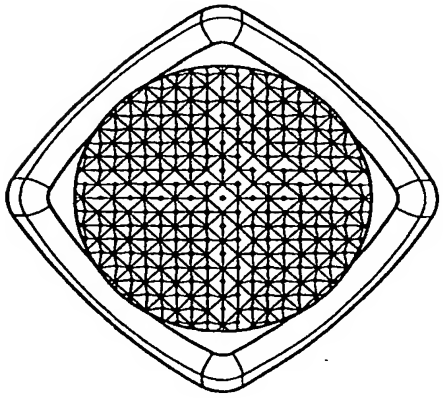


Fig. 24c

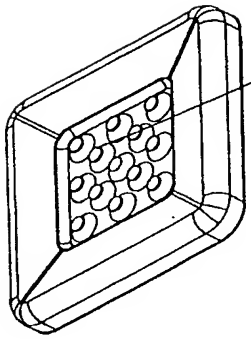


Fig. 25a

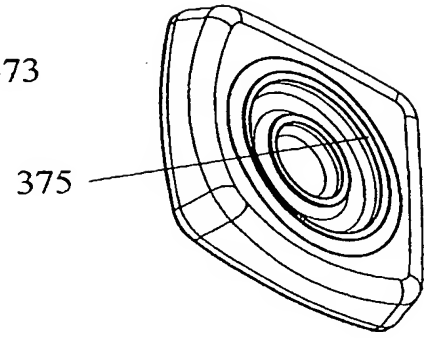


Fig. 26a

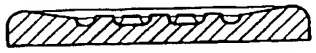


Fig. 25b

Fig. 26b

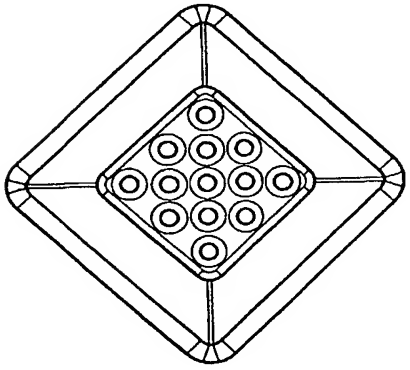


Fig. 25c

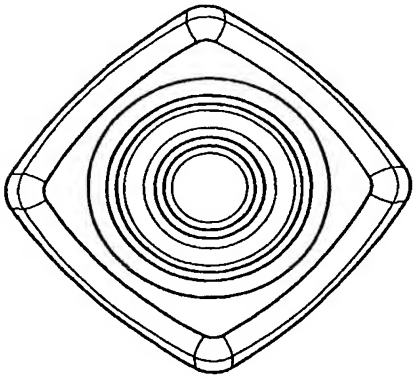


Fig. 26c

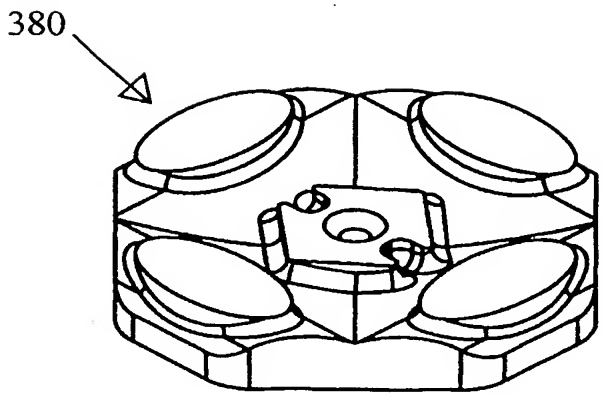


Fig. 27a

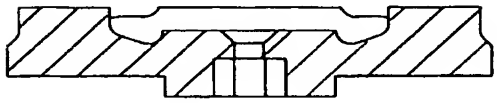


Fig. 27b

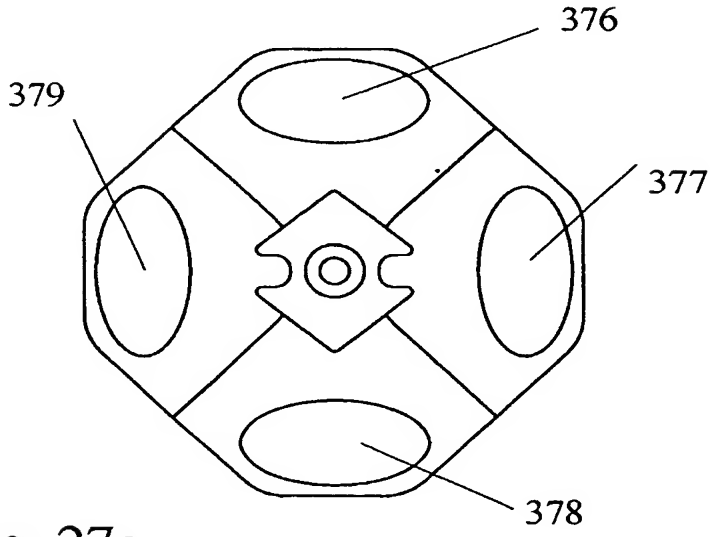


Fig. 27c

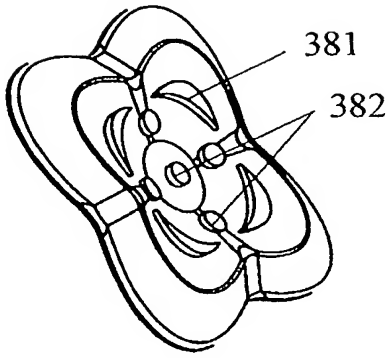


Fig. 28a

Fig. 28b

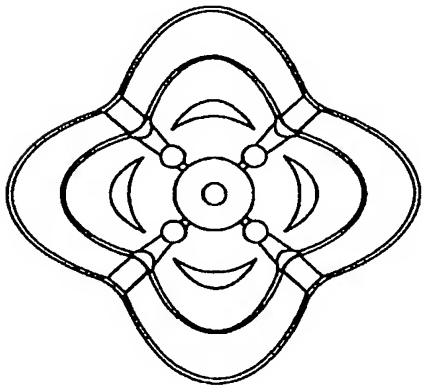


Fig. 28c

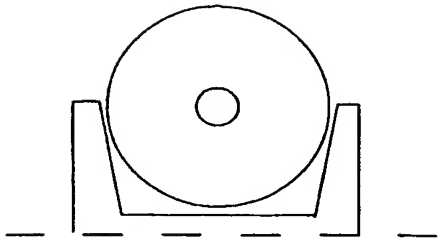


Fig. 29a

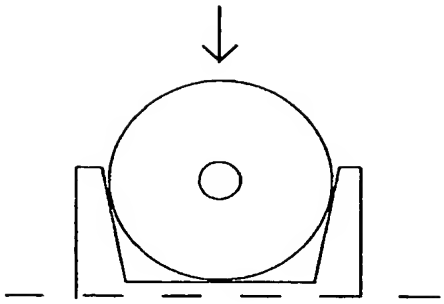


Fig. 29b

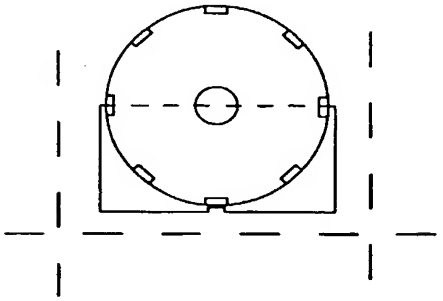


Fig 30

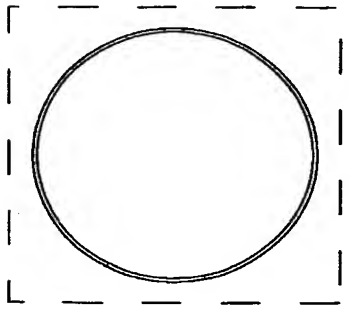


Fig. 31a

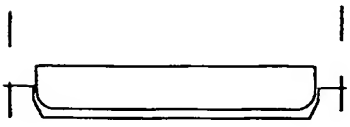


Fig. 31b

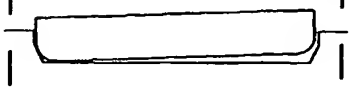


Fig. 31c

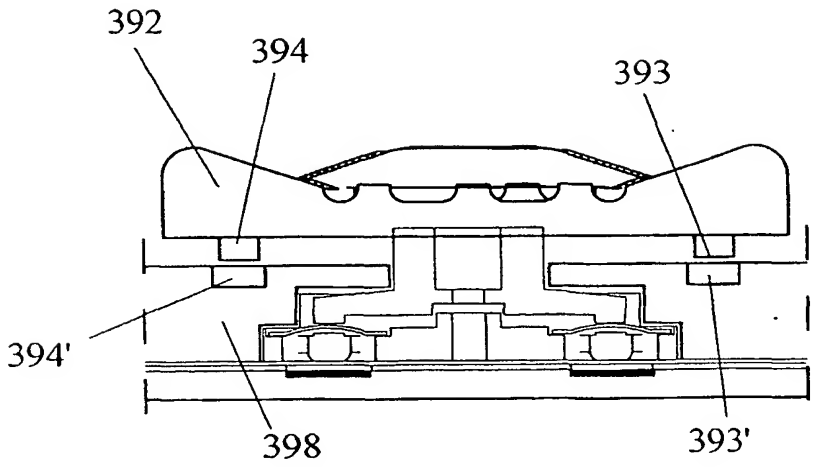


Fig. 32

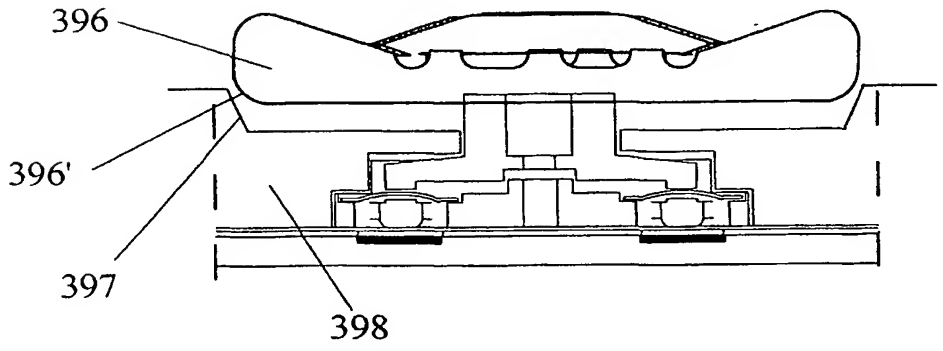


Fig. 33

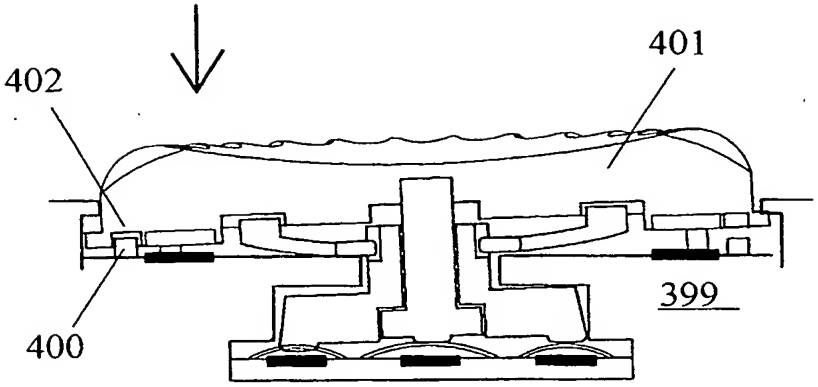


Fig. 34a

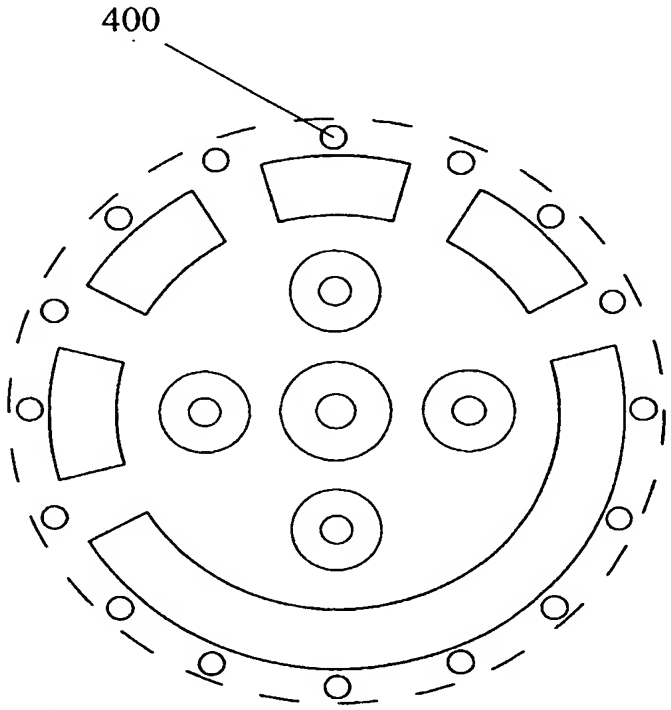


Fig. 34b

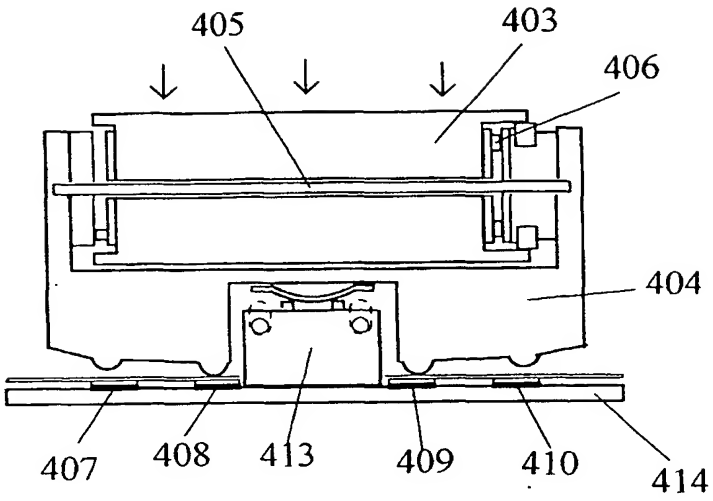


Fig. 35a

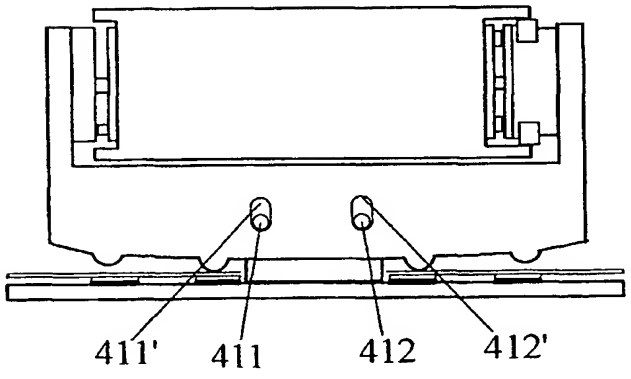


Fig. 35b

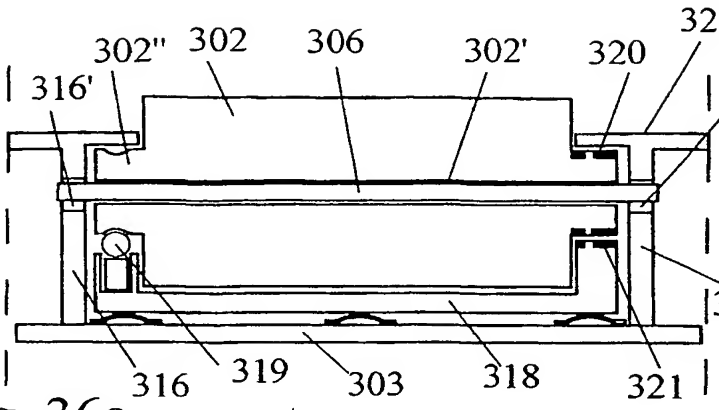


Fig. 36a

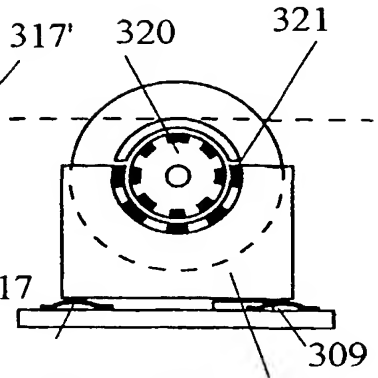


Fig. 36d

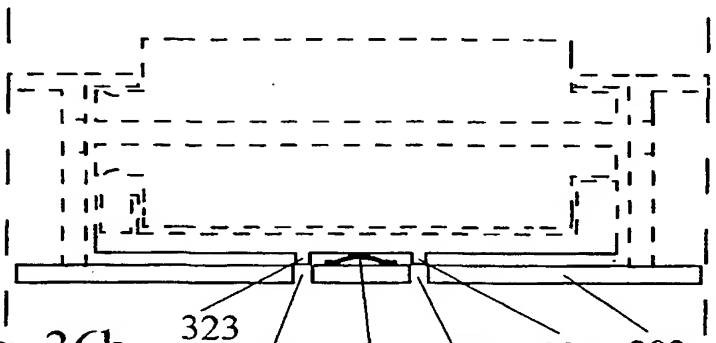


Fig. 36b

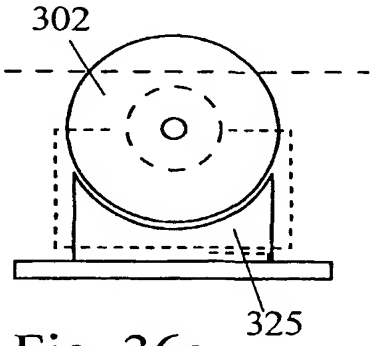


Fig. 36e

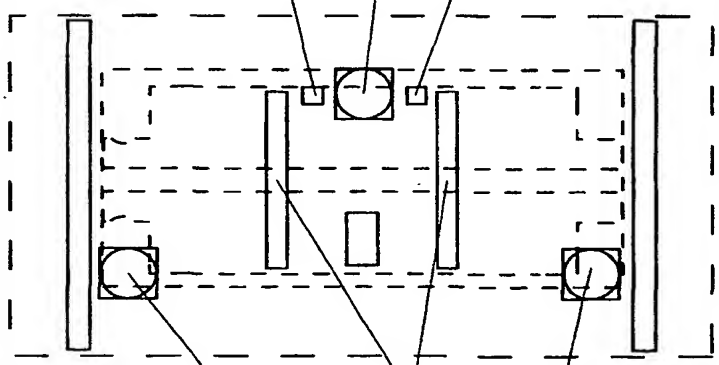


Fig. 36c

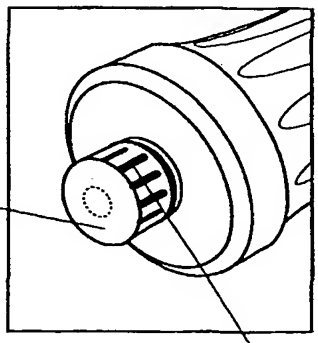


Fig. 36g

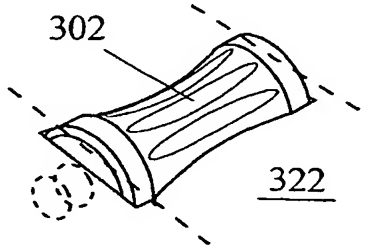


Fig. 36f

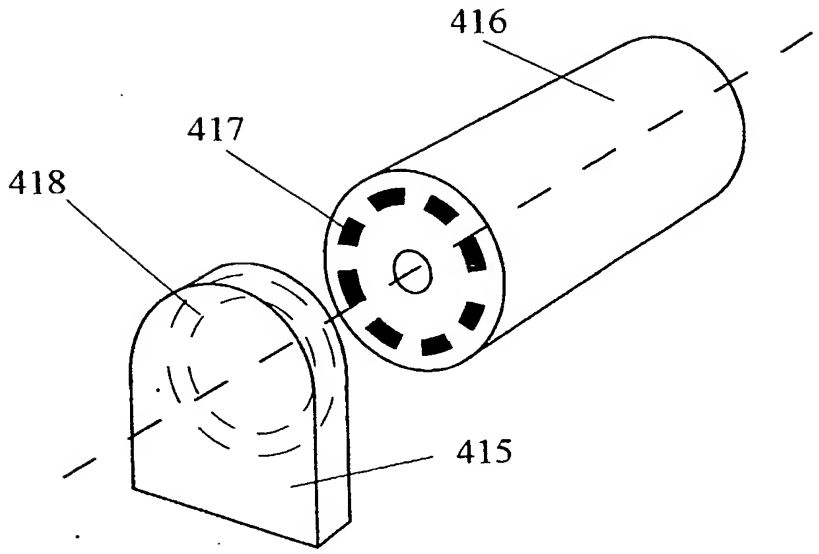


Fig. 37

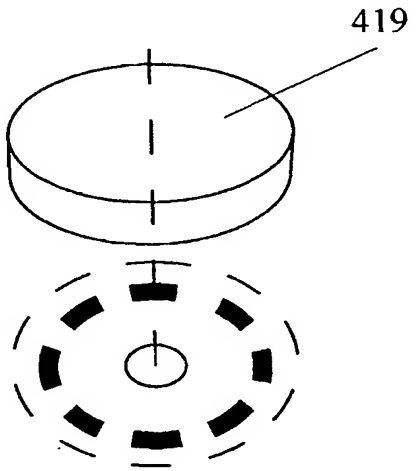


Fig. 38

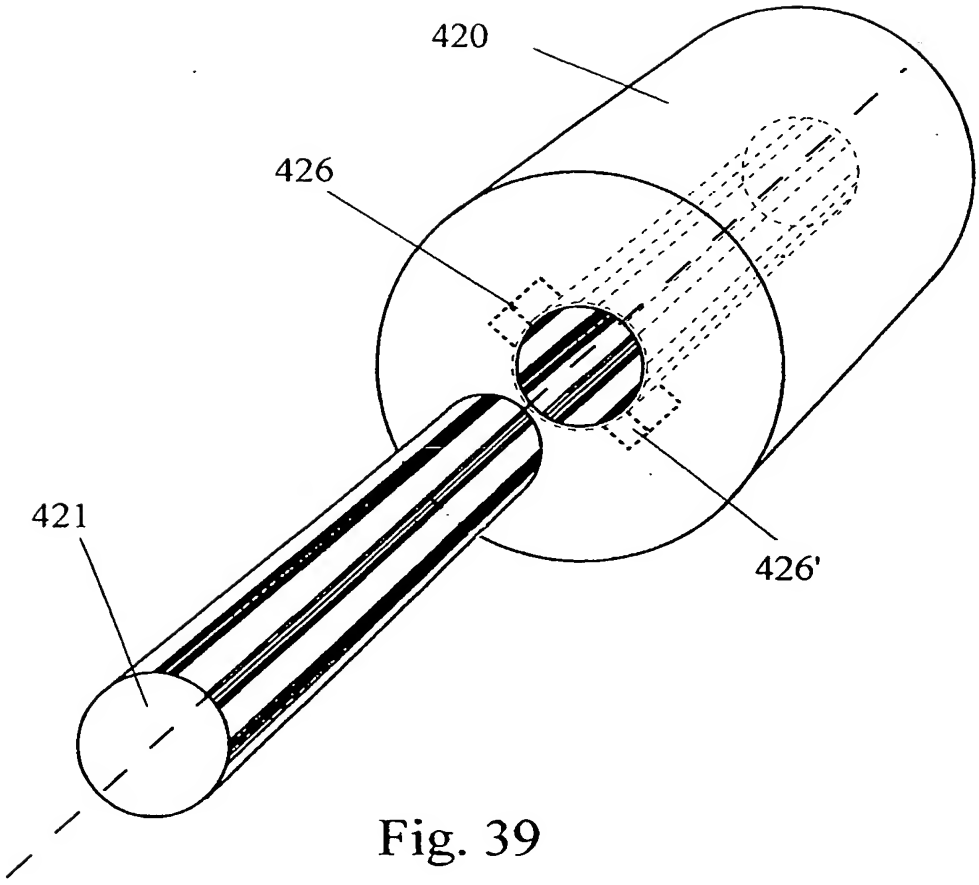


Fig. 39

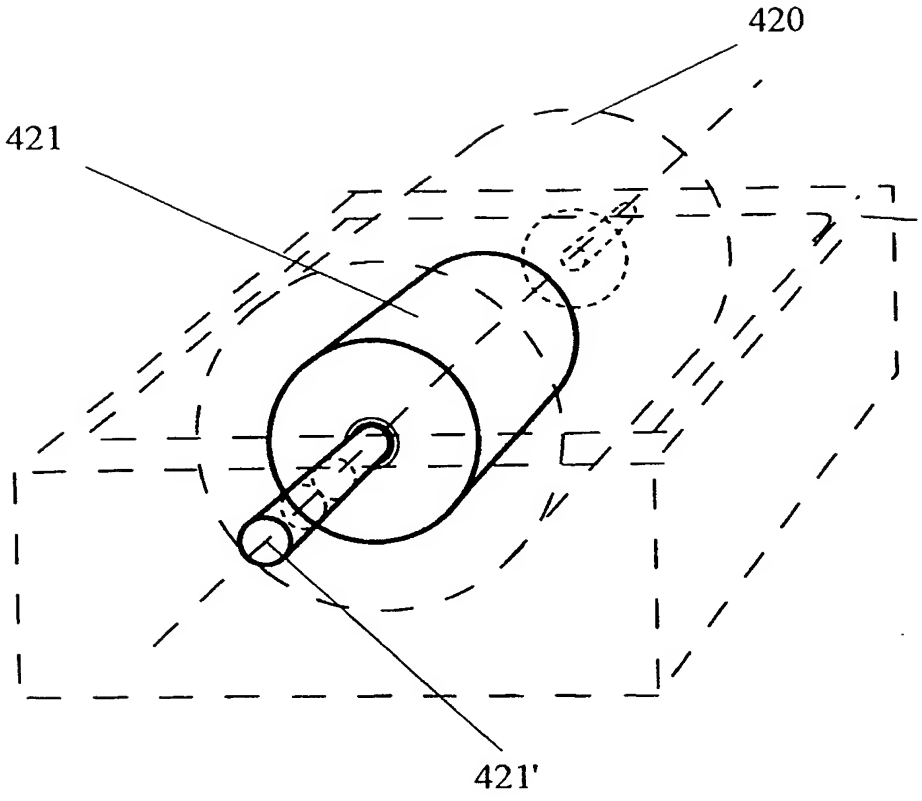


Fig 40

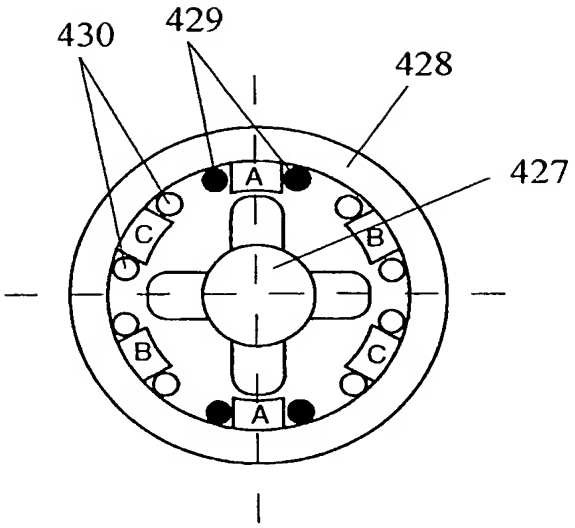


Fig 41a

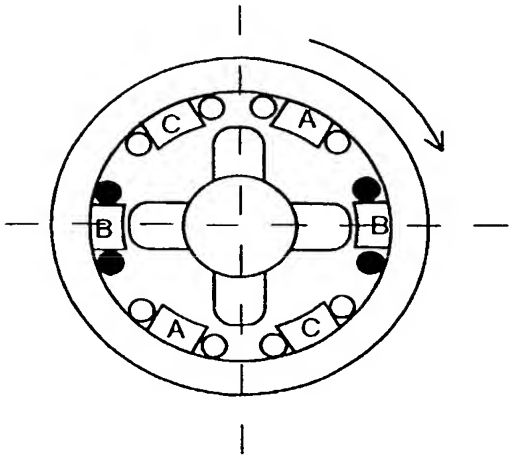


Fig 41b

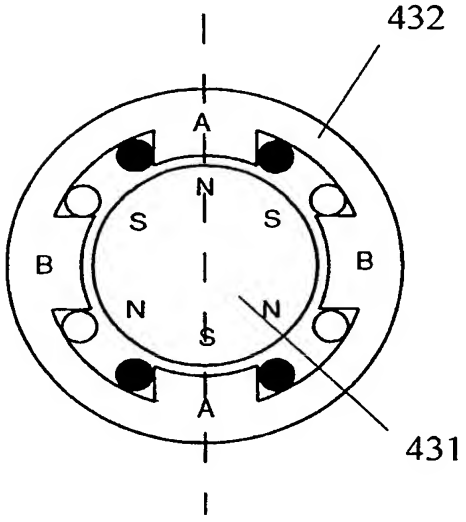


Fig 42a

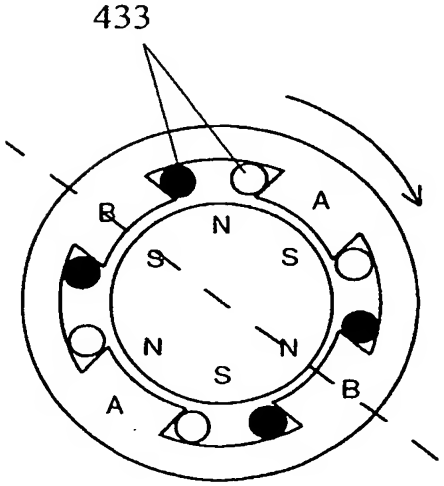


Fig 42b

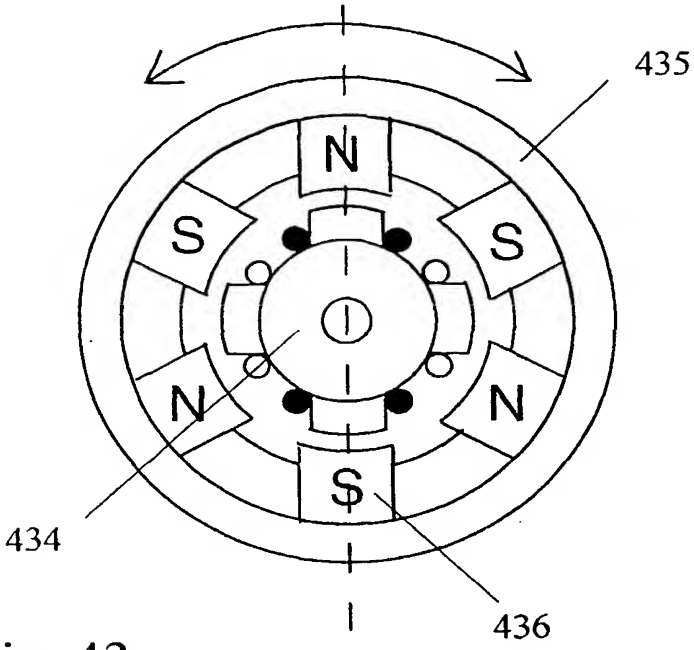


Fig. 43

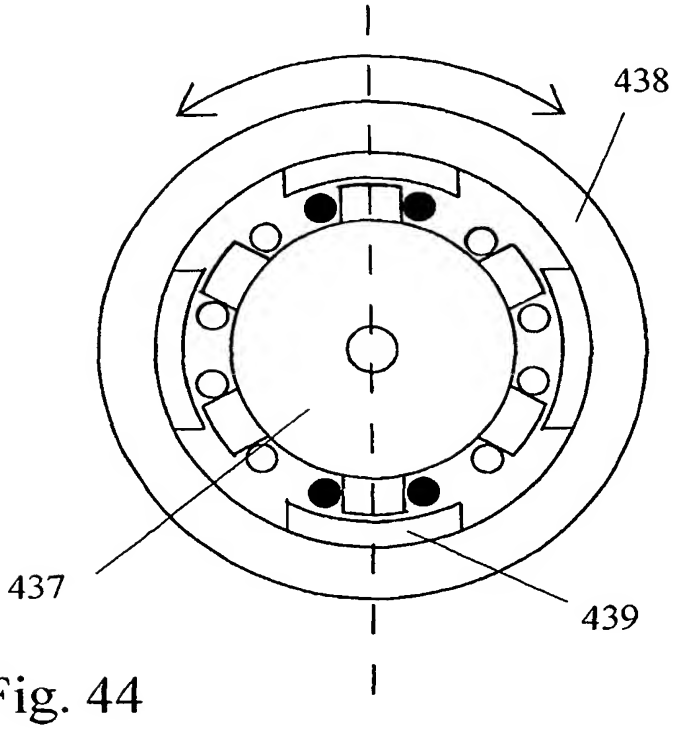


Fig. 44

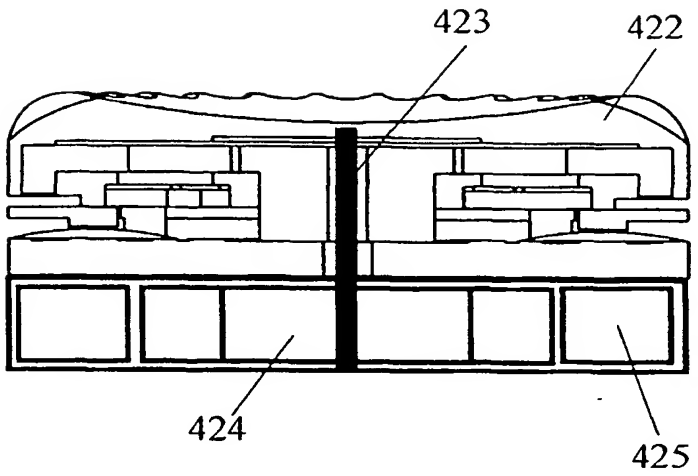


Fig. 45

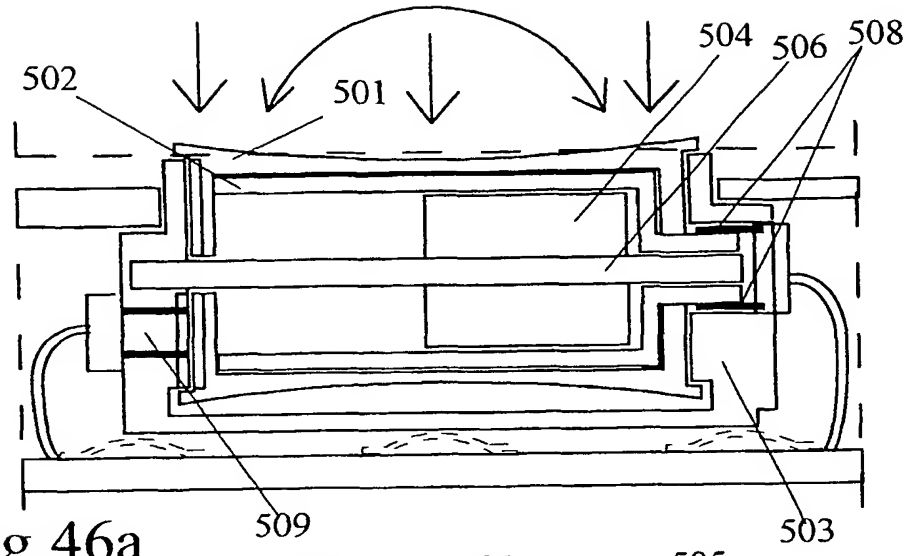


Fig 46a

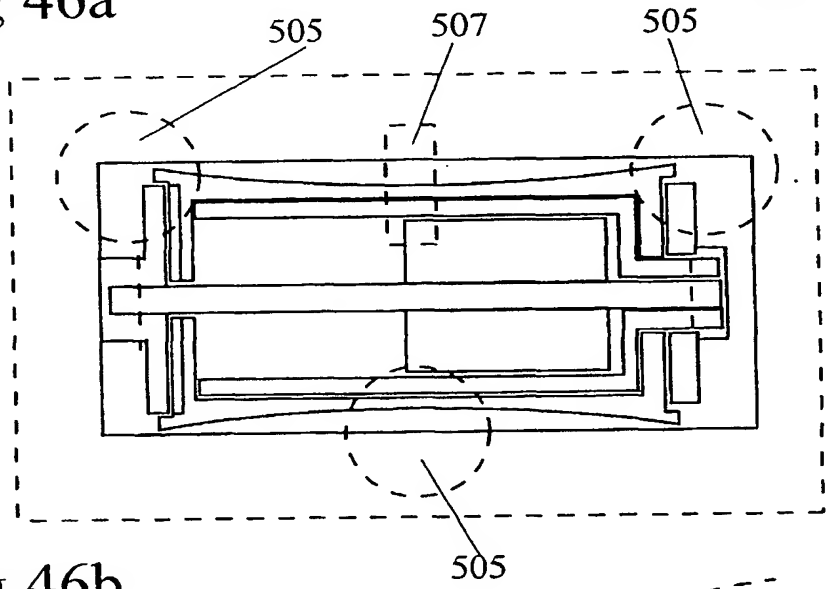


Fig 46b

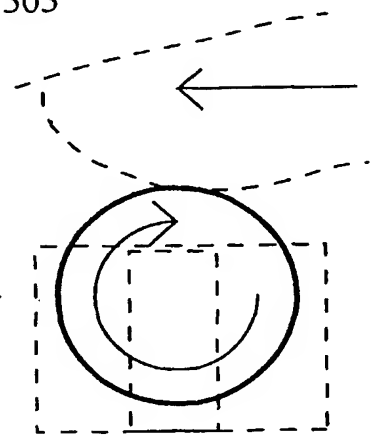


Fig 46c

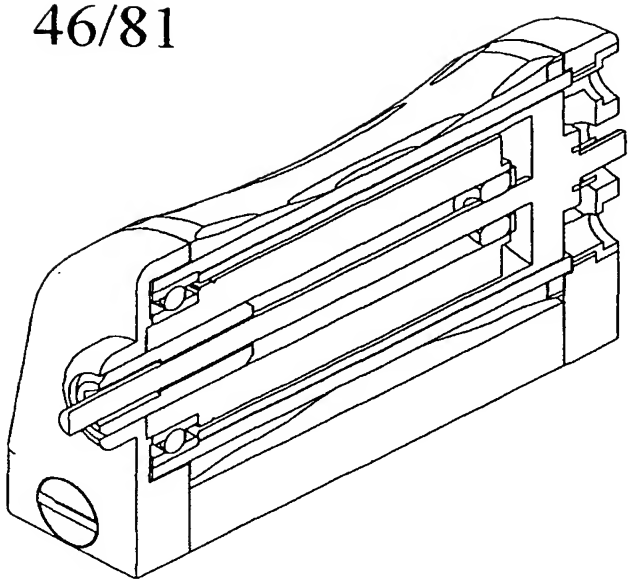


Fig. 47a

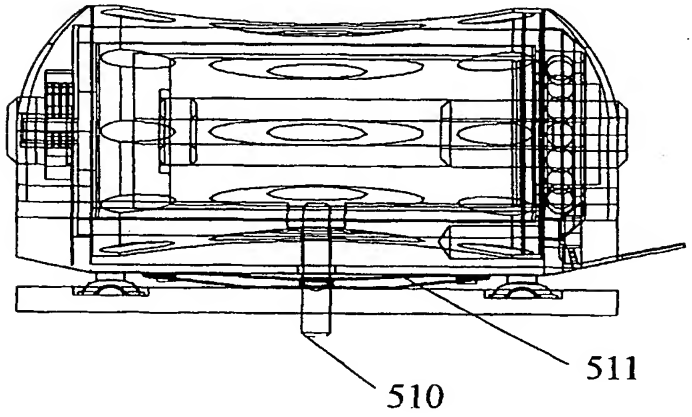


Fig. 47b

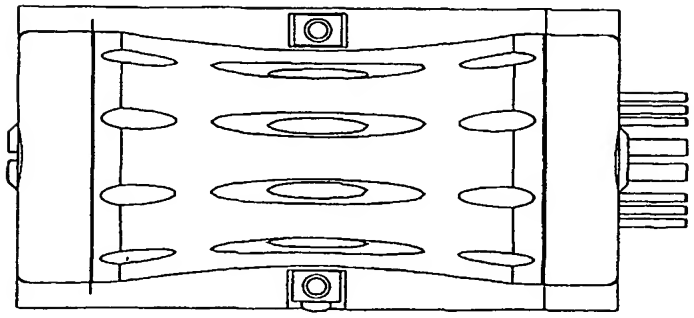


Fig. 47c

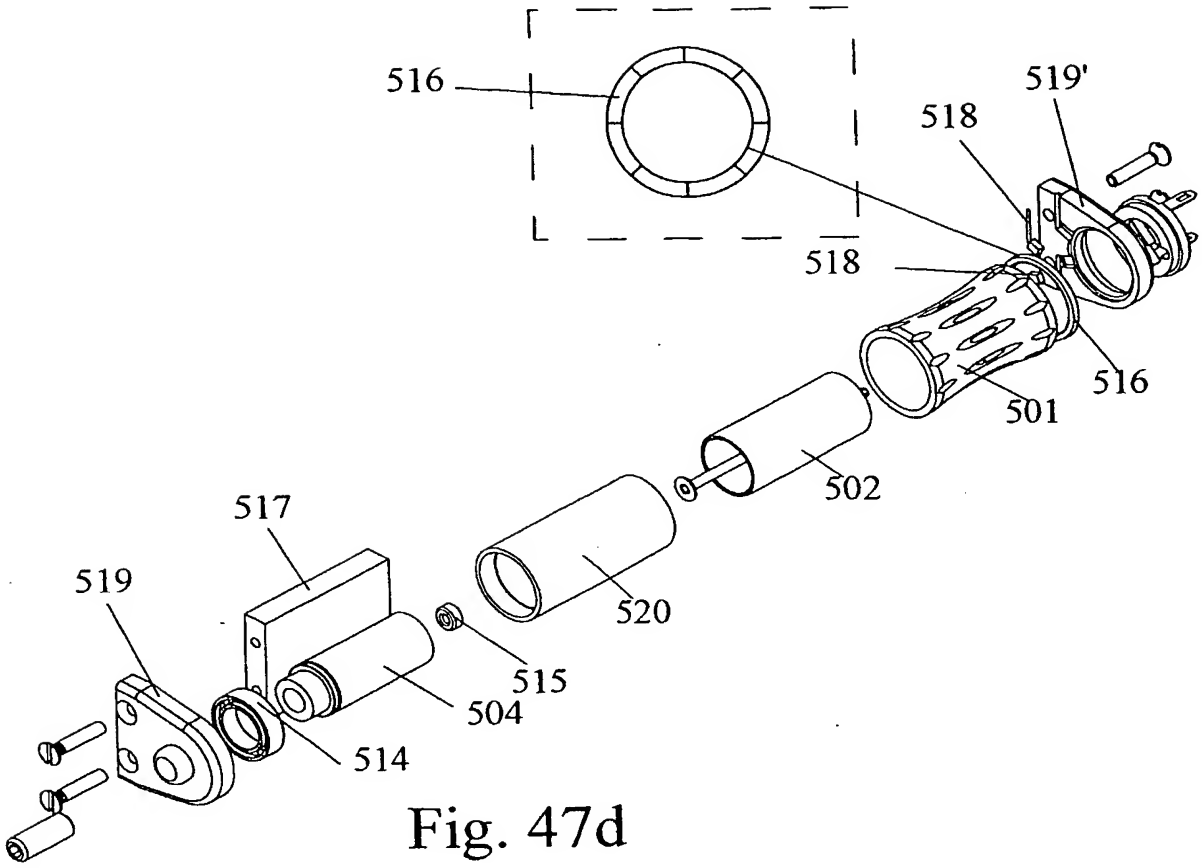


Fig. 47d

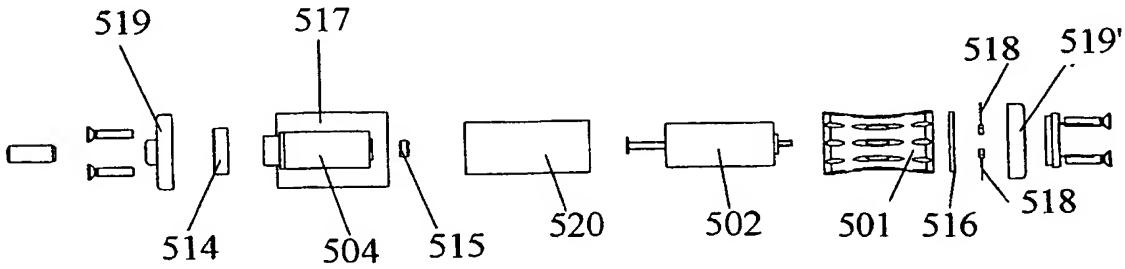


Fig. 47e

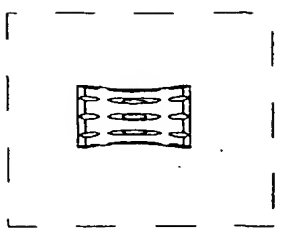


Fig. 47f

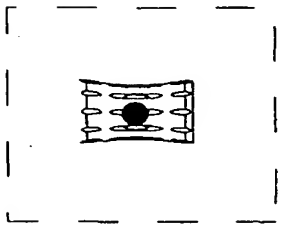


Fig. 47j

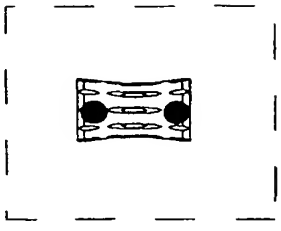


Fig. 47n

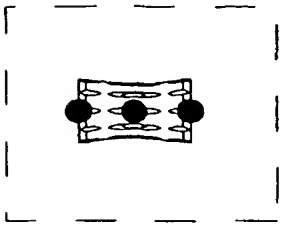


Fig. 47r

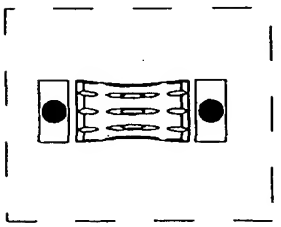


Fig. 47g

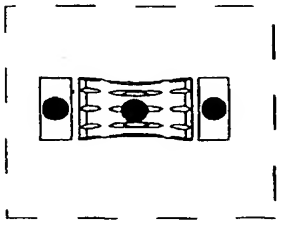


Fig. 47k

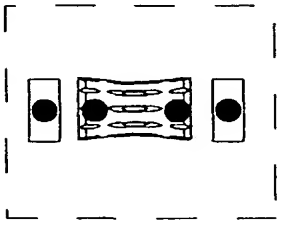


Fig. 47o

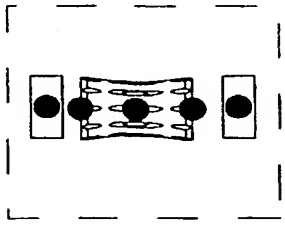


Fig. 47s

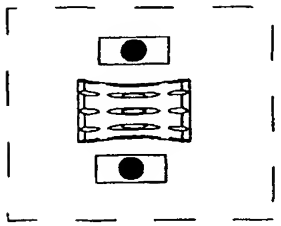


Fig. 47h

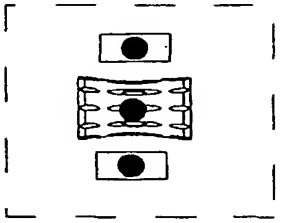


Fig. 47l

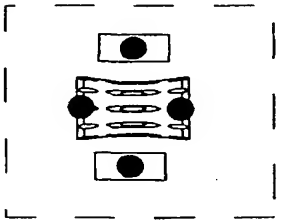


Fig. 47p

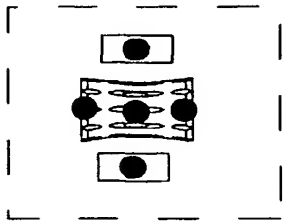


Fig. 47t

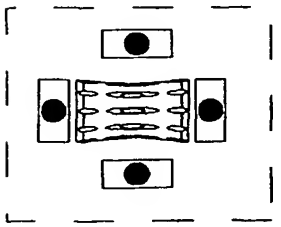


Fig. 47i

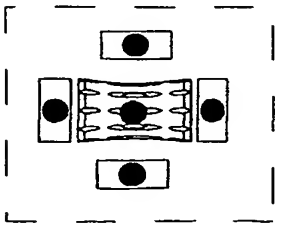


Fig. 47m

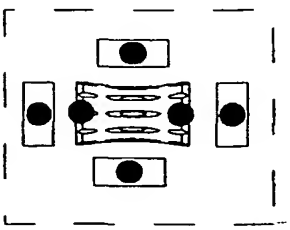


Fig. 47q

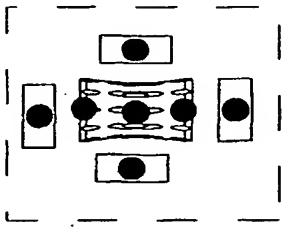


Fig. 47u

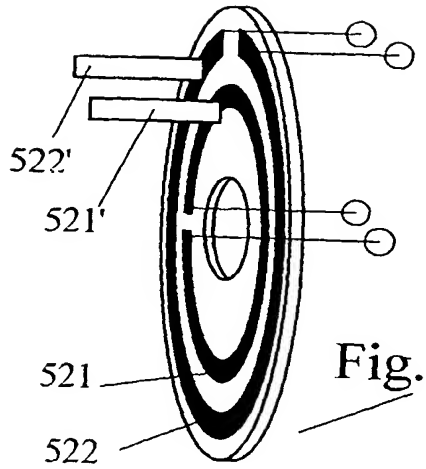
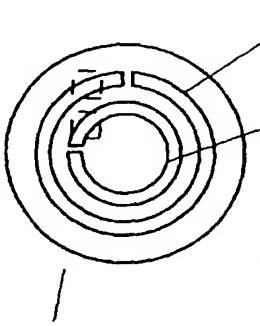


Fig. 48a



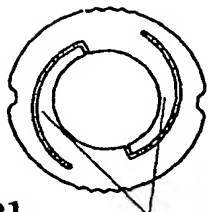
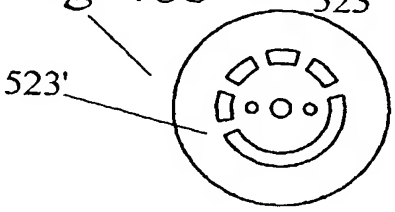


Fig. 48b



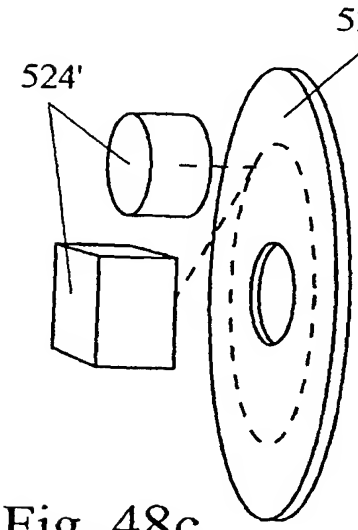


Fig. 48c

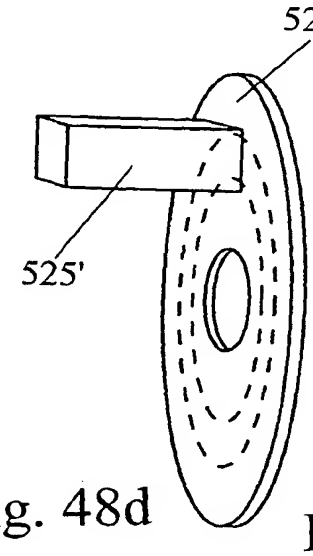


Fig. 48d

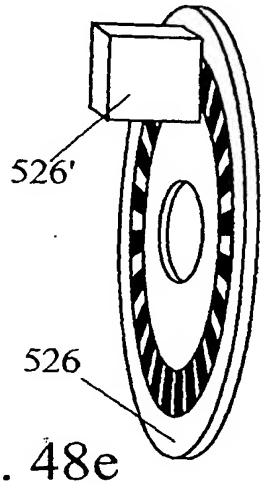


Fig. 48e

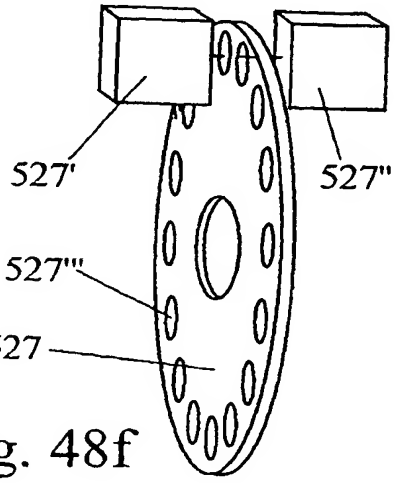


Fig. 48f

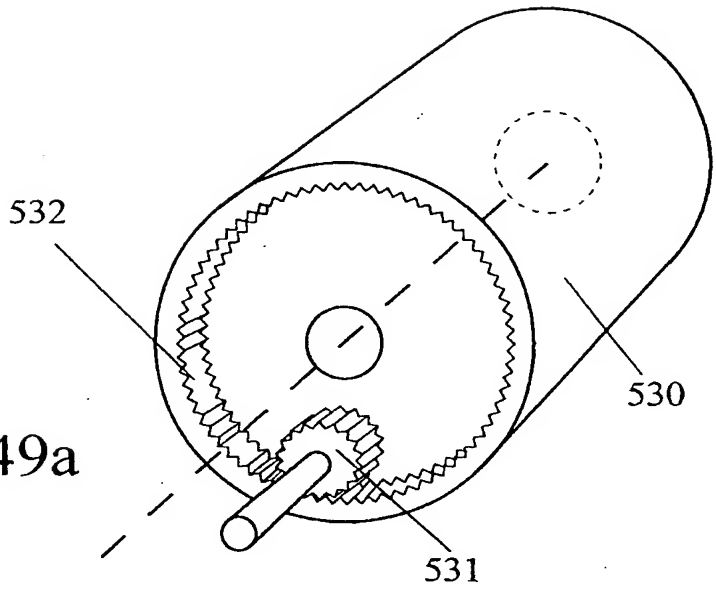


Fig. 49a

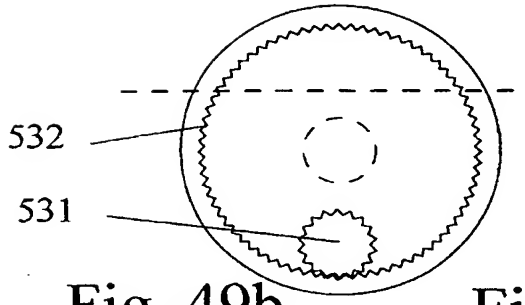


Fig. 49b

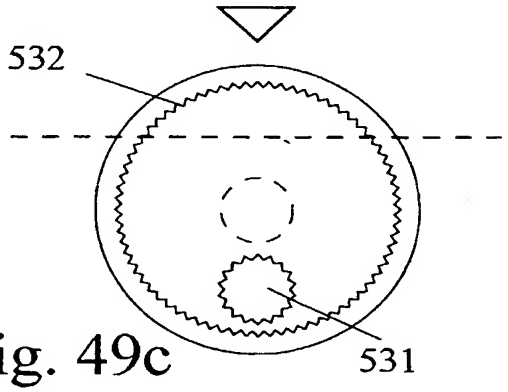


Fig. 49c

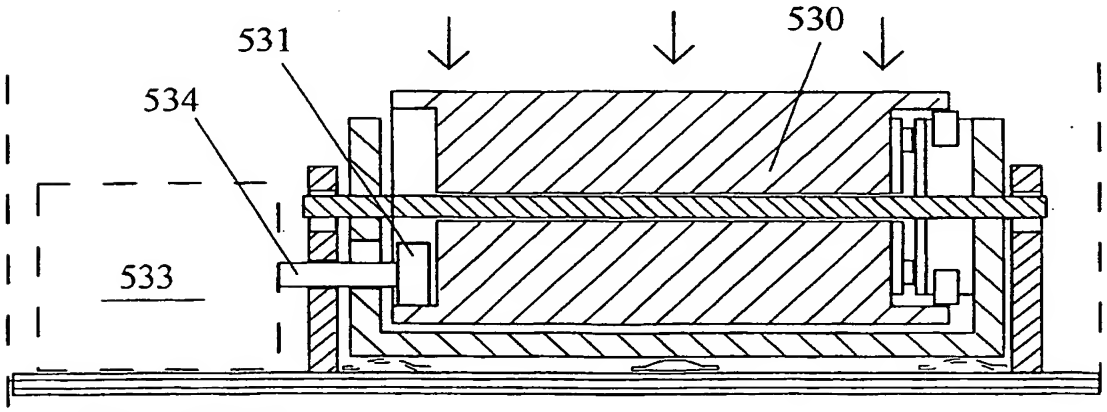


Fig. 49d

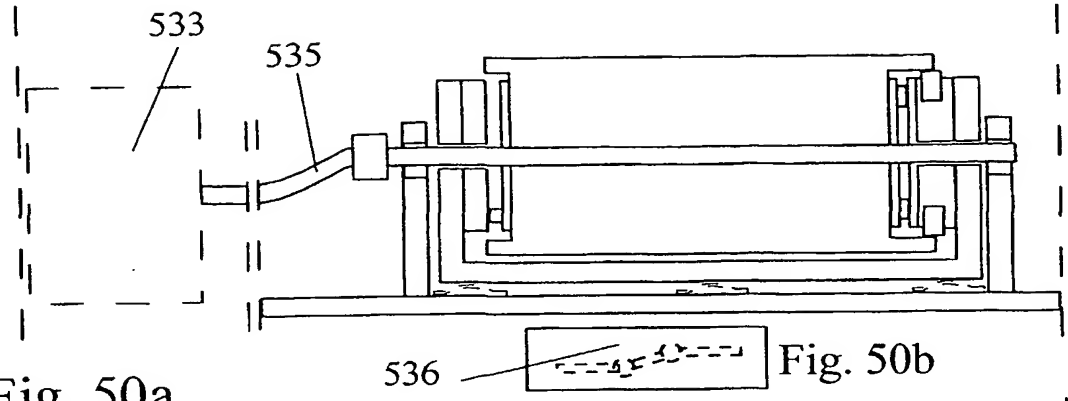


Fig. 50a

Fig. 50b

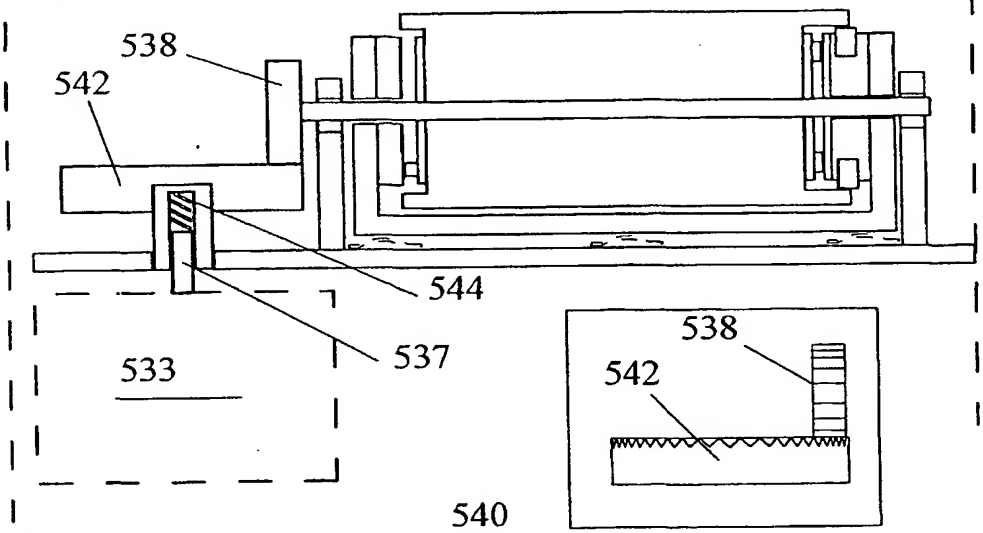


Fig. 51a

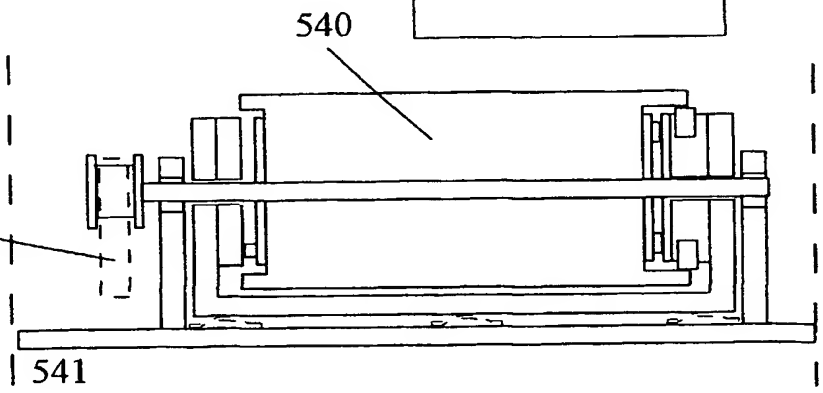


Fig. 52a

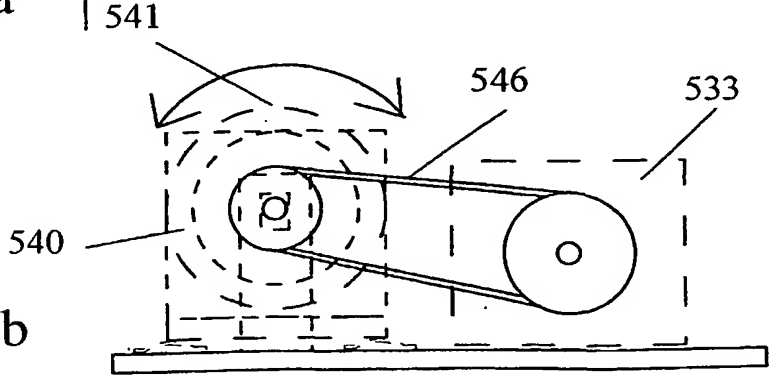


Fig. 52b

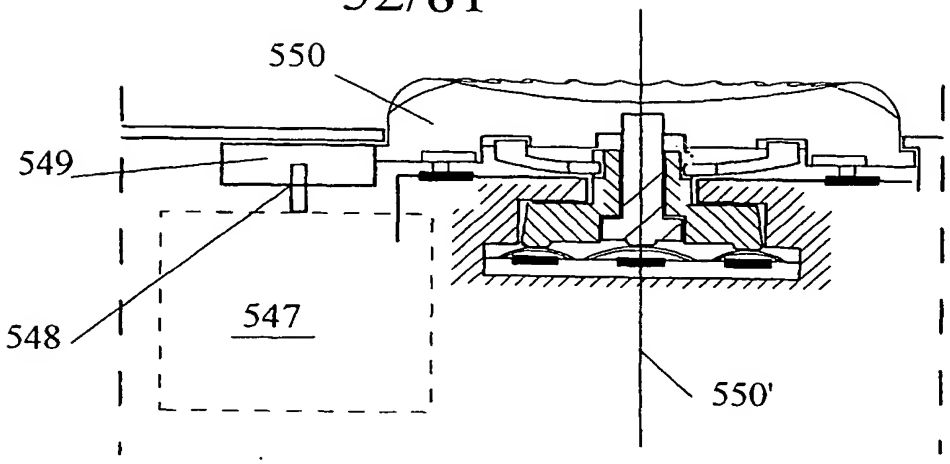


Fig. 53a

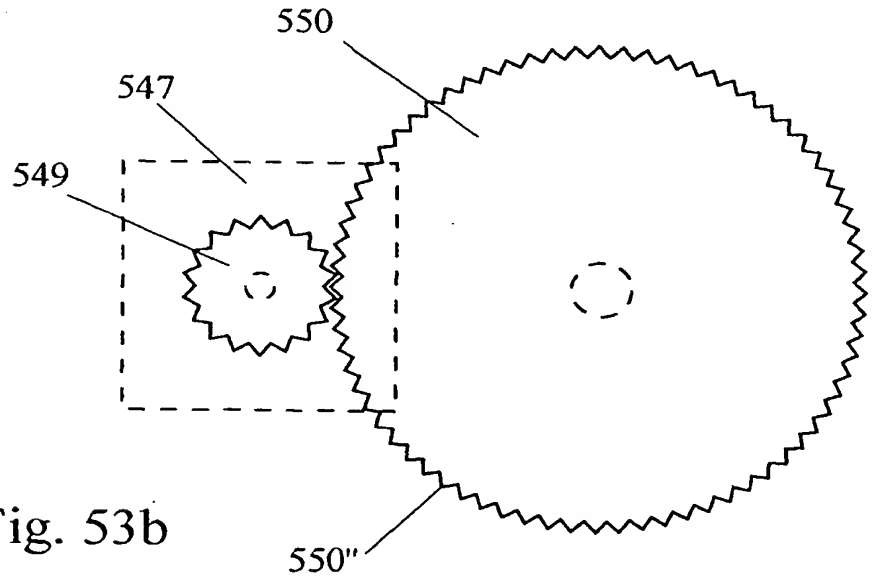


Fig. 53b

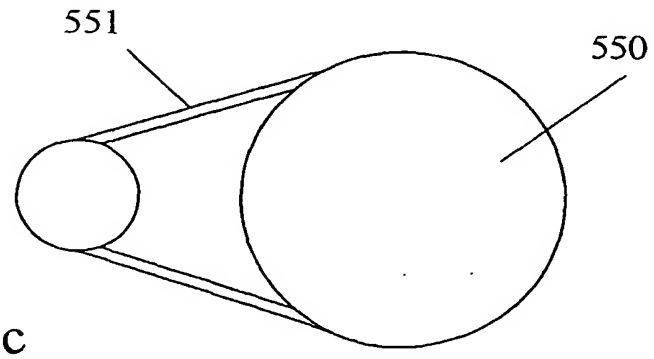


Fig. 53c

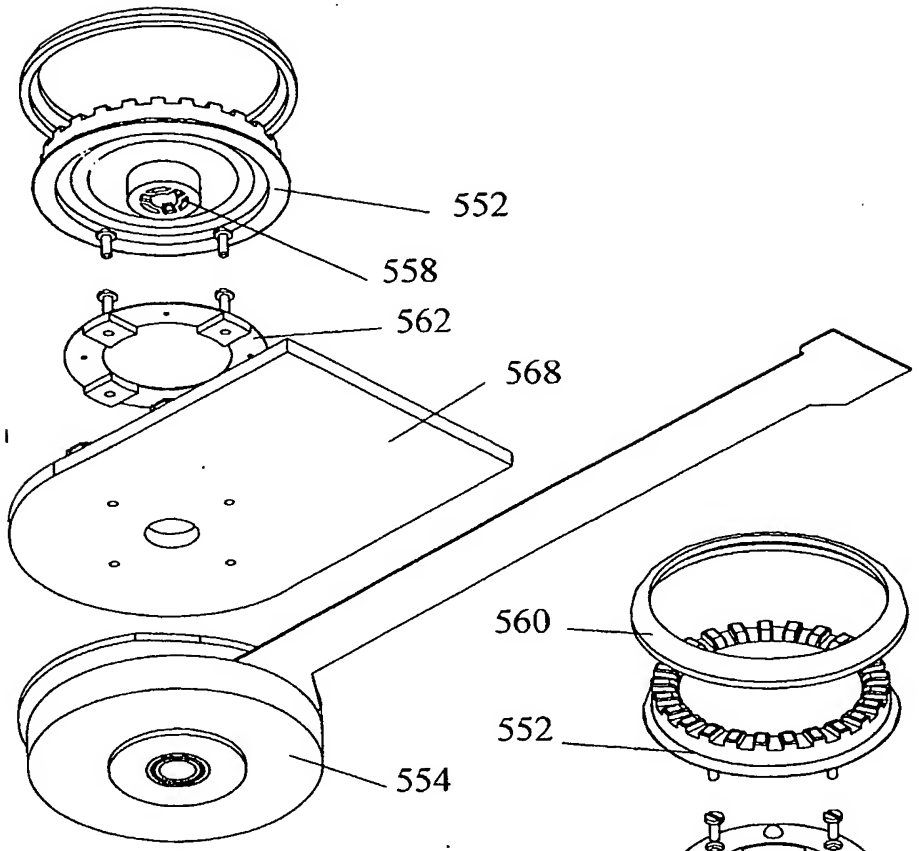


Fig. 54a

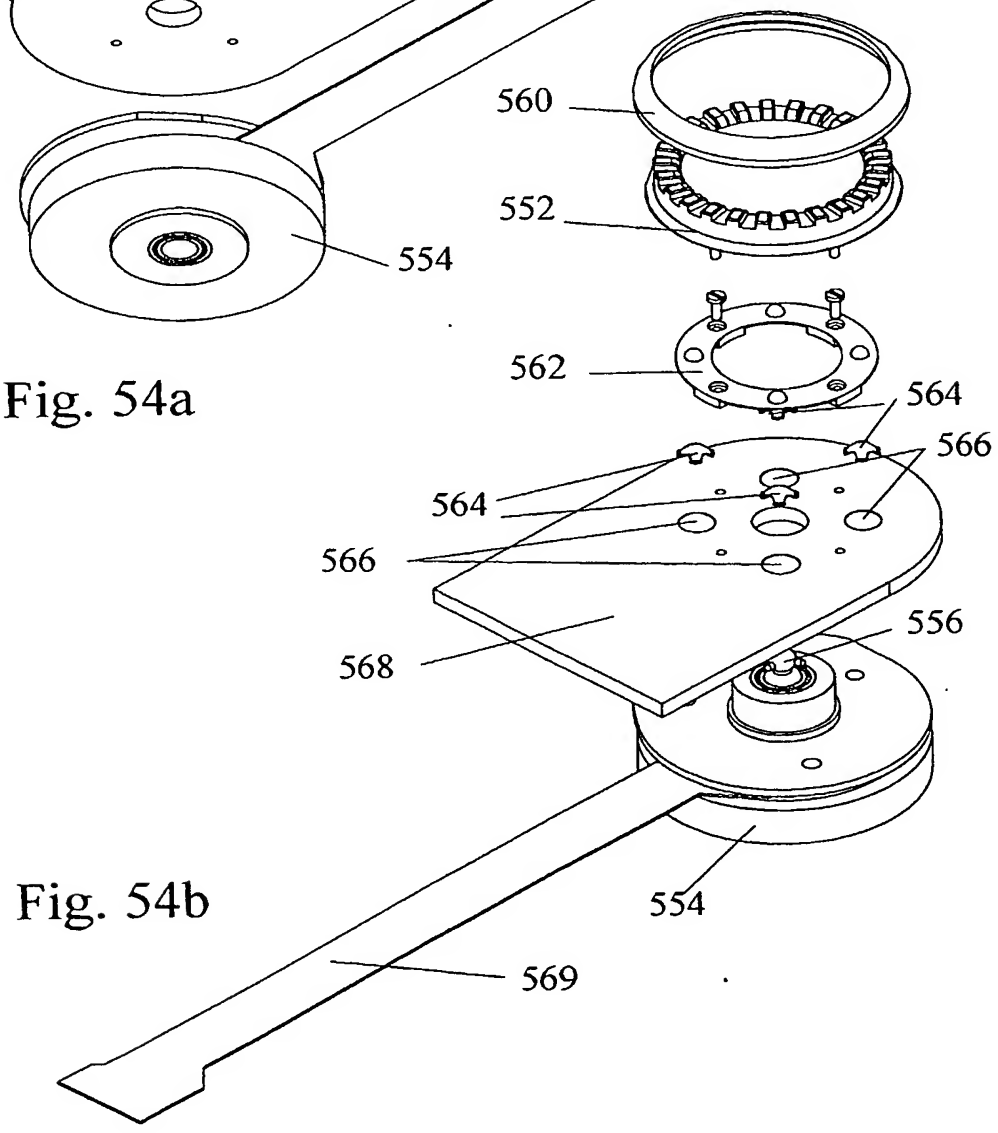


Fig. 54b

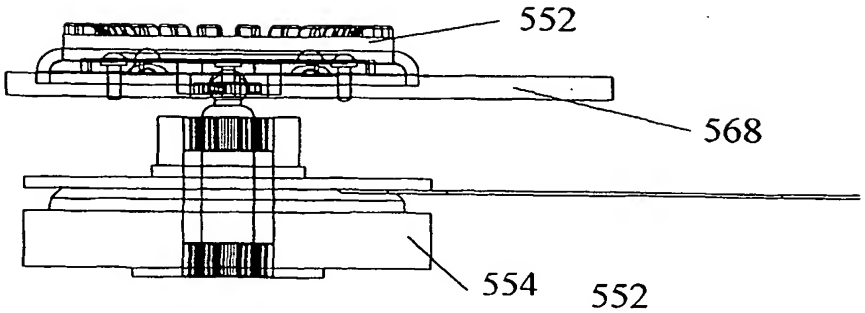


Fig. 54c

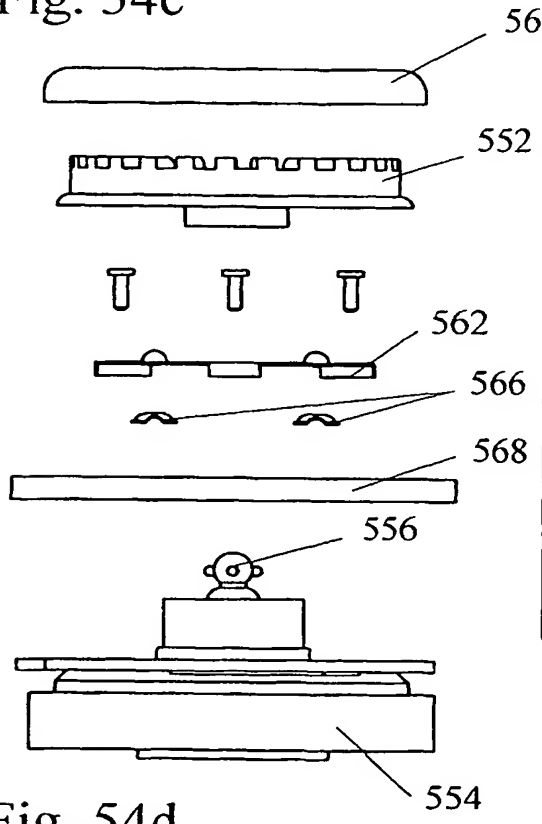


Fig. 54d

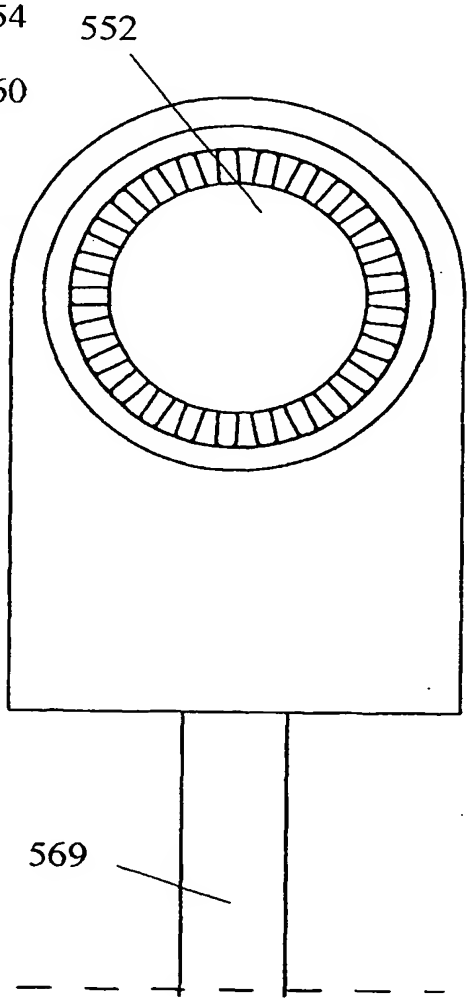


Fig. 54e

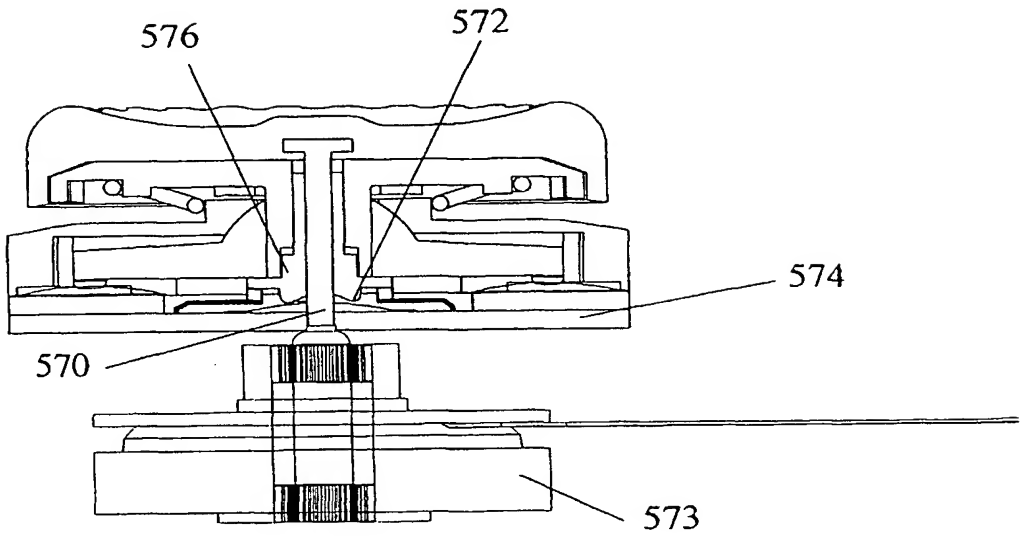


Fig. 55

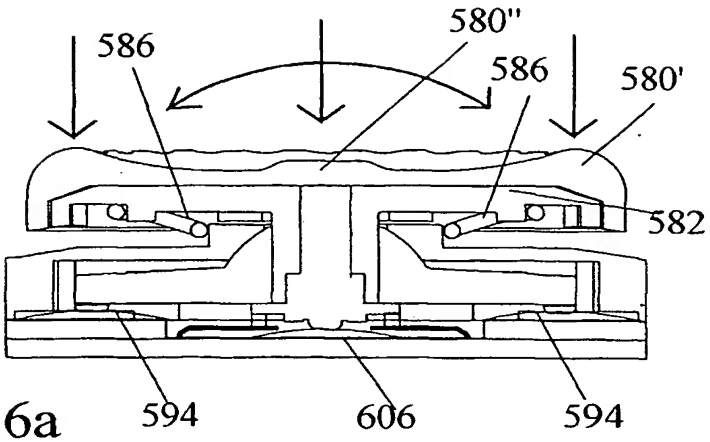


Fig. 56a

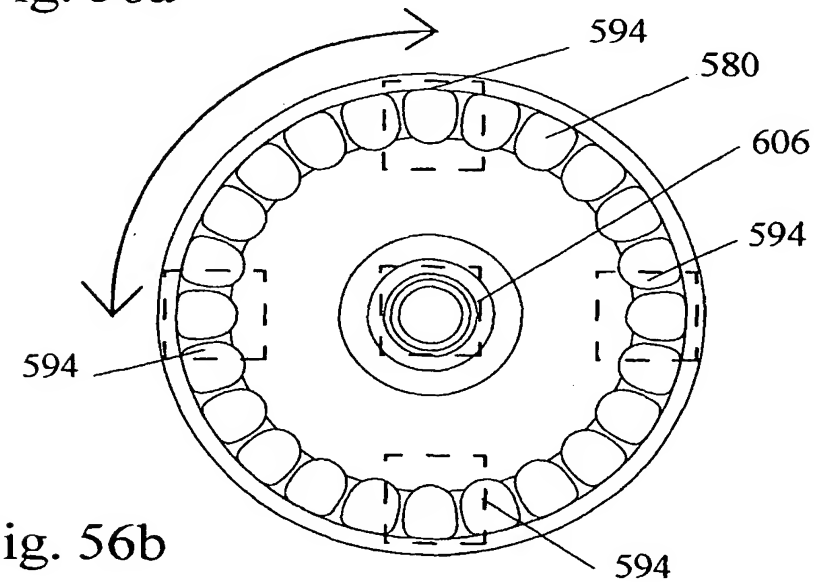


Fig. 56b

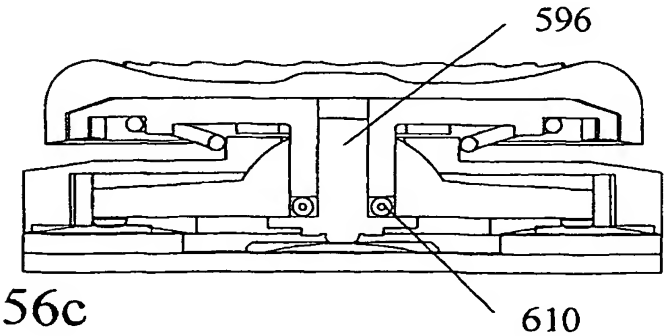


Fig. 56c

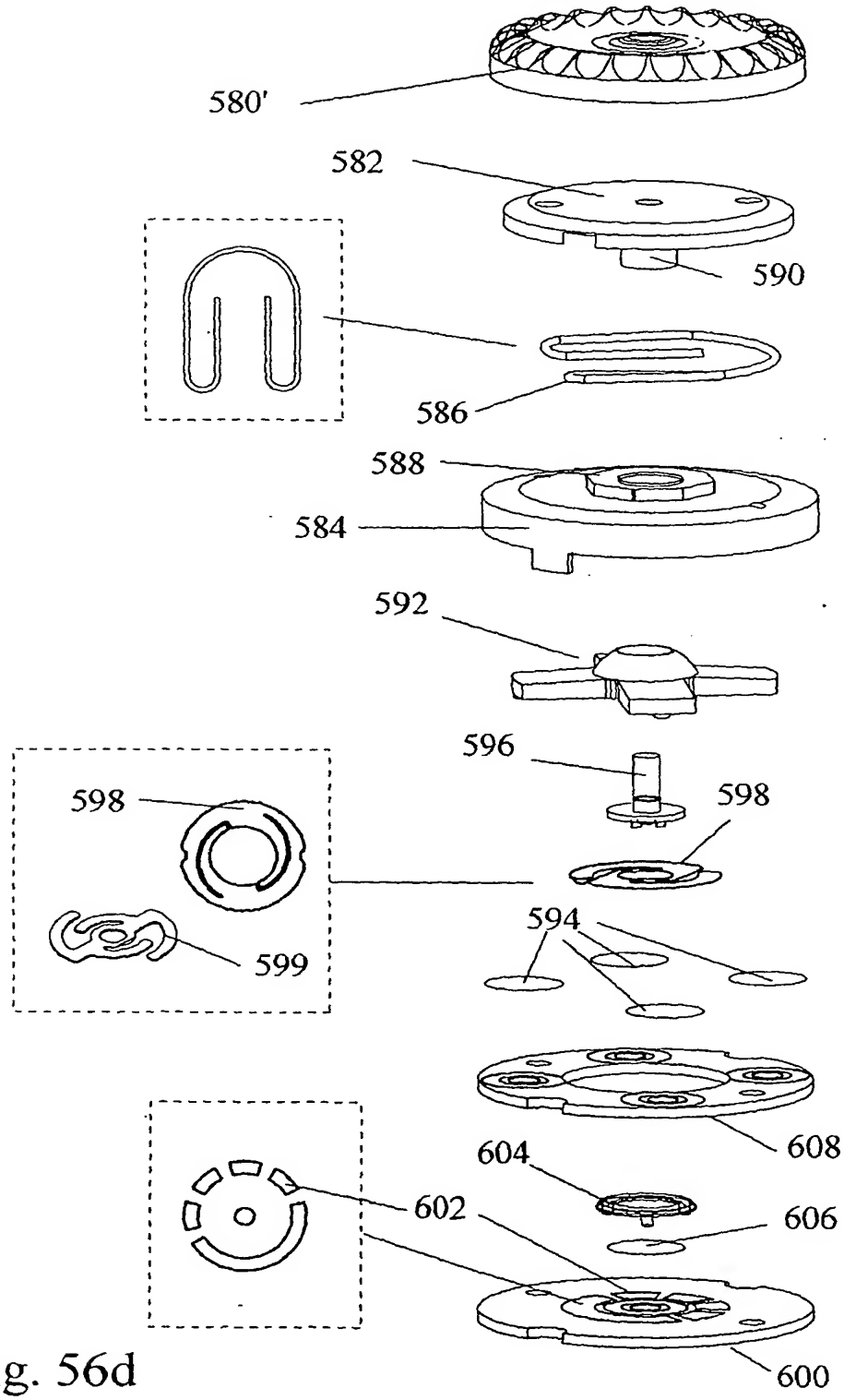

580'
582
590
586
588
584
592
596
598
598
599
594
608
604
606
602
600

Fig. 56d

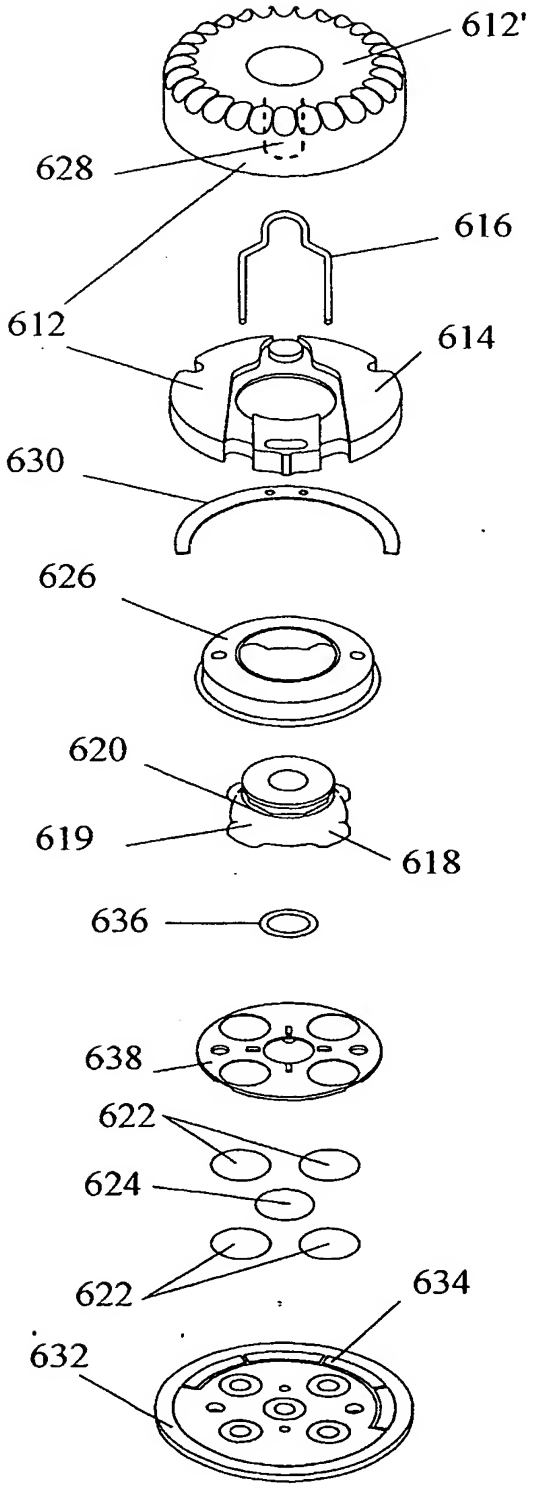

612'
628
616
612
614
630
626
620
619
618
636
638
622
624
622
634
632

Fig. 57a

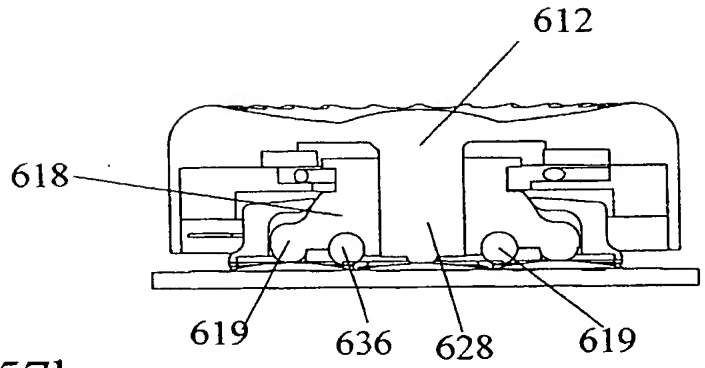


Fig. 57b

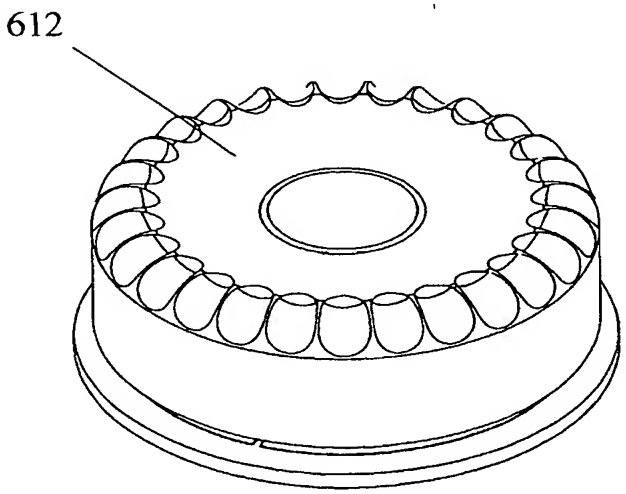


Fig. 57c

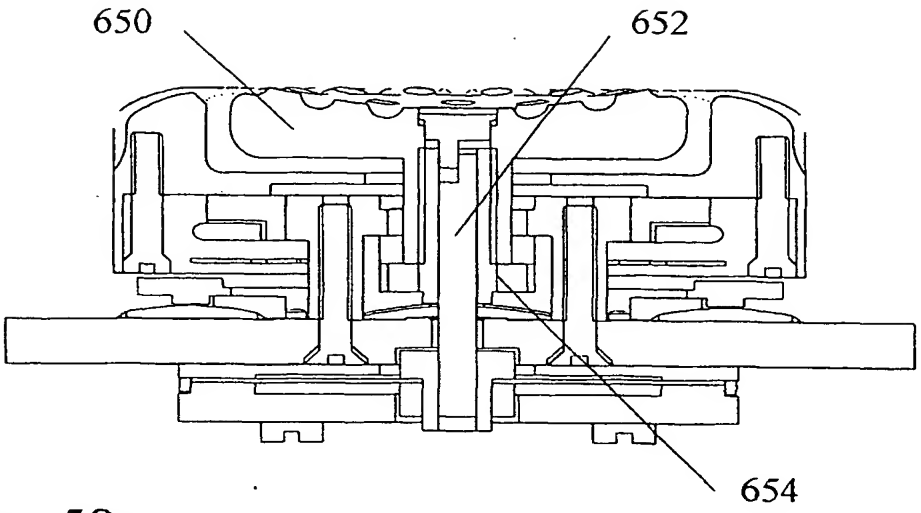


Fig. 58a

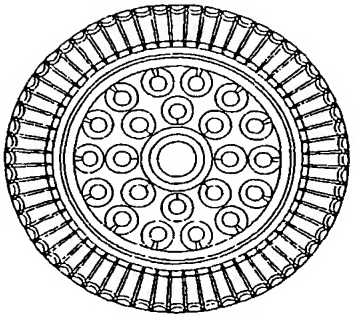


Fig. 58b

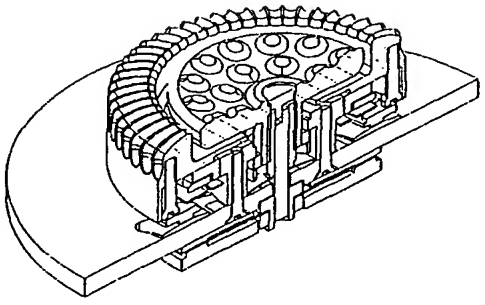


Fig. 58c

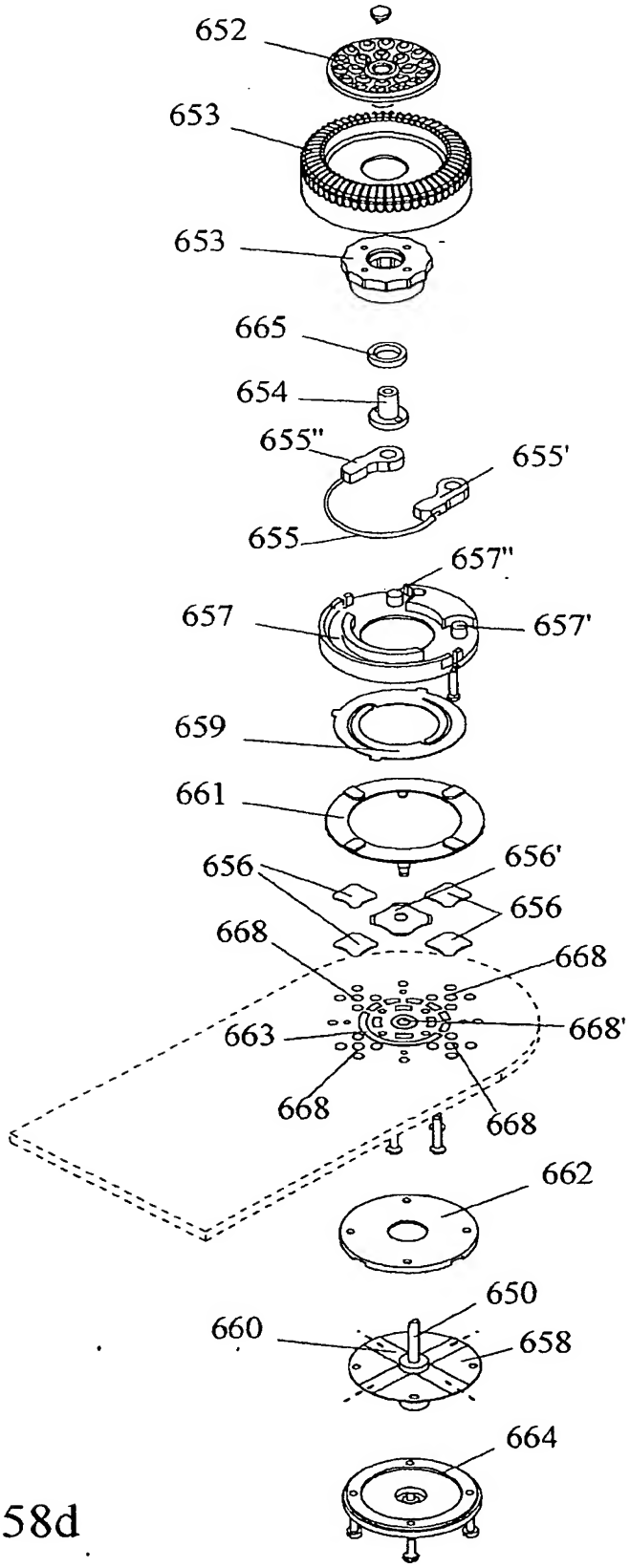

652
653
653
665
654
655"
655'
655
657"
657
657'
659
661
656
656'
656
668
668
663
668'
668
668
662
650
660
658
664

Fig. 58d

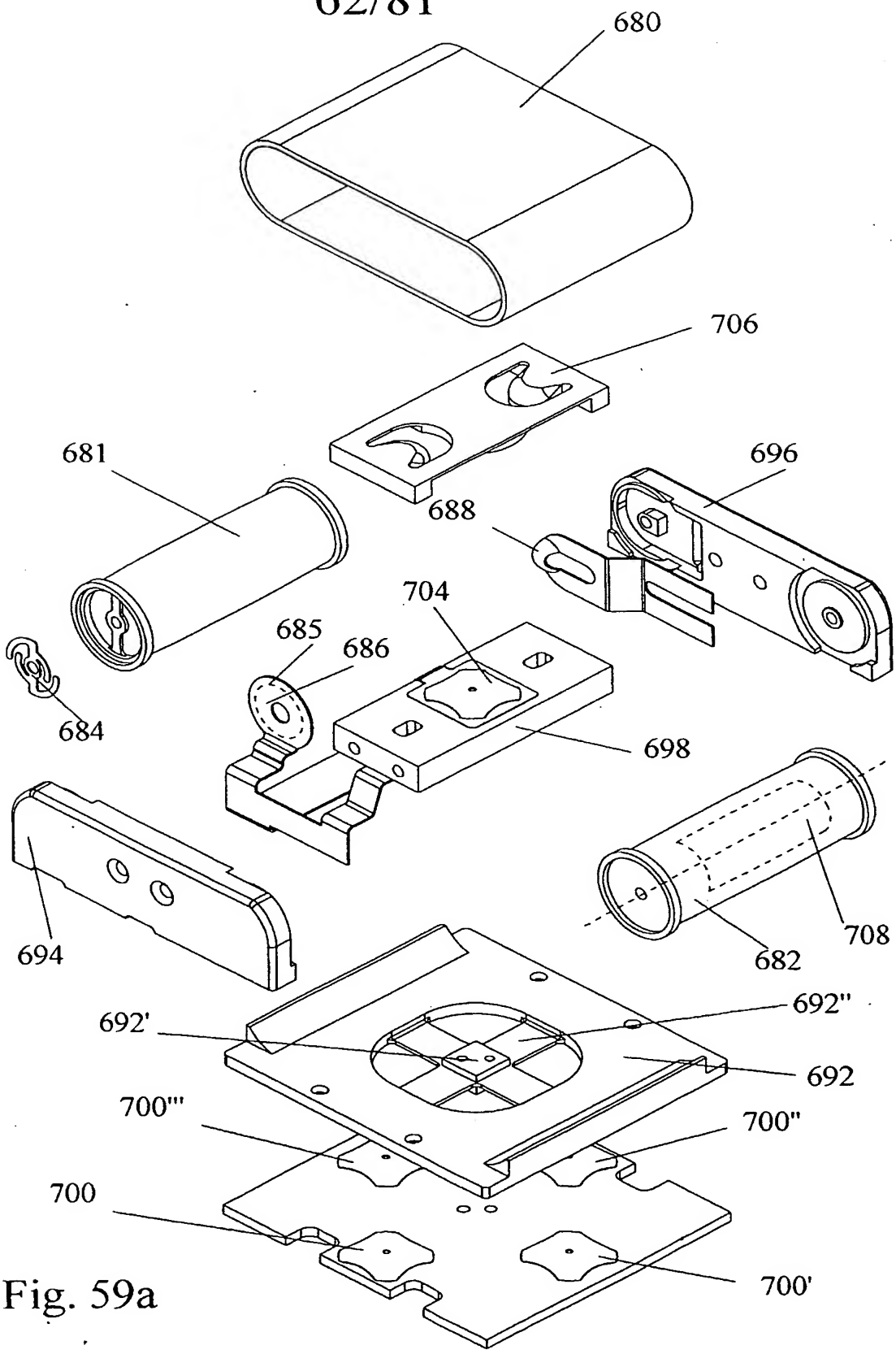

680
706
681
696
688
704
685
686
684
698
694
708
682
692"
692'
692
700'''
700"
700
700'

Fig. 59a

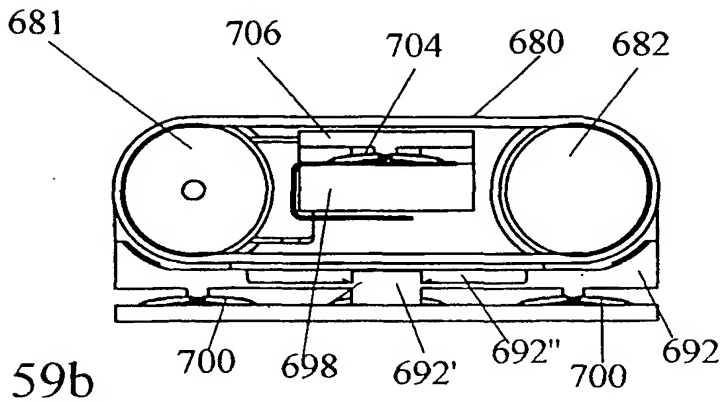


Fig. 59b

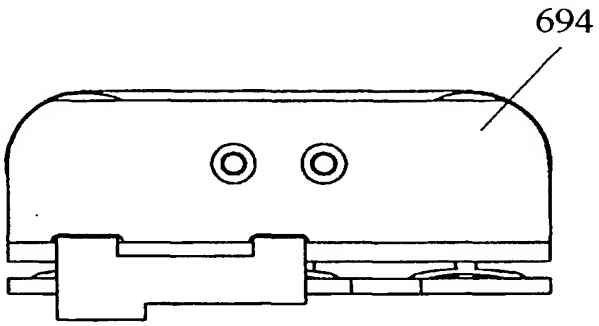


Fig. 59c

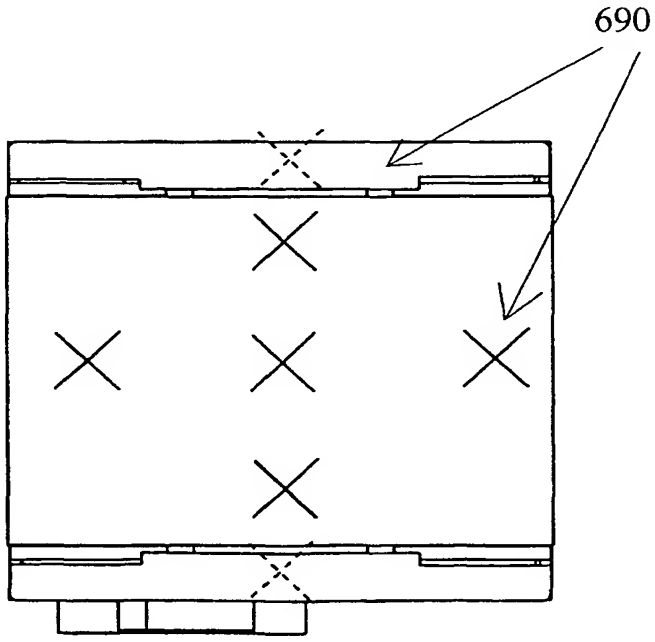


Fig. 59d

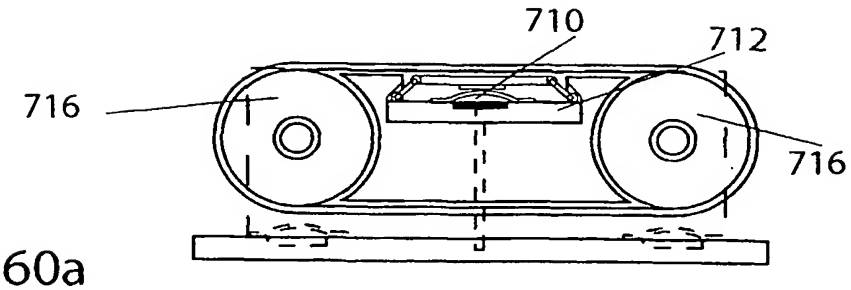


Fig. 60a

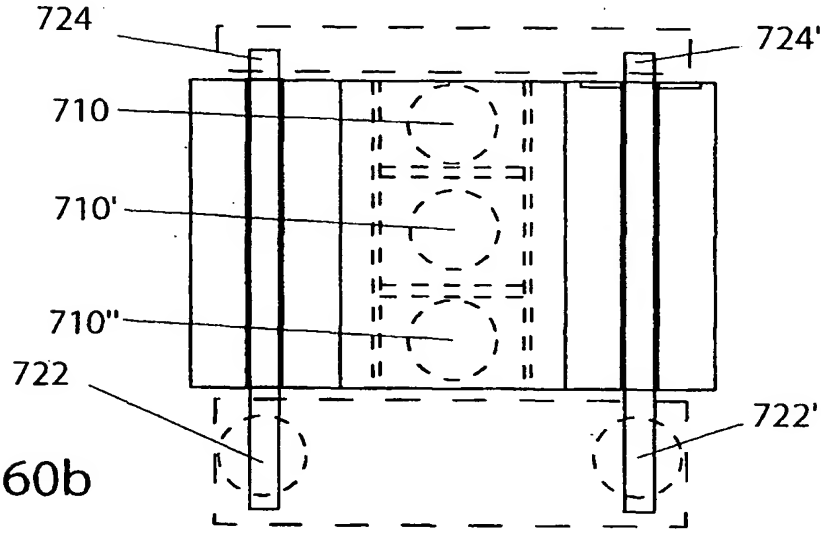


Fig. 60b

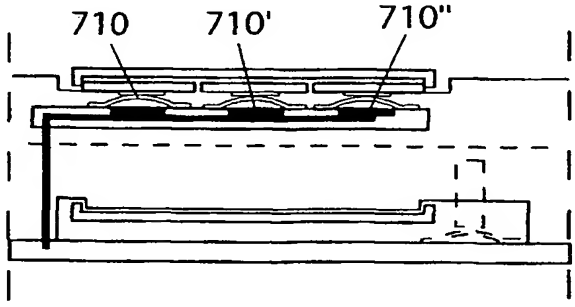


Fig. 60c

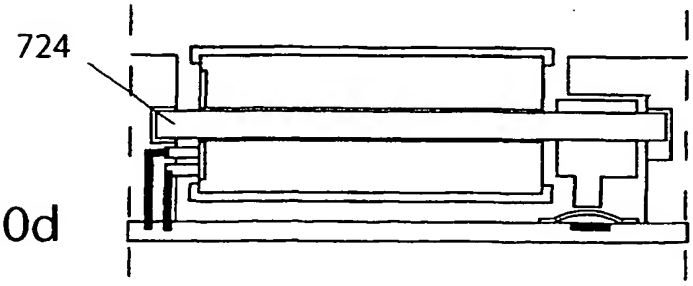


Fig. 60d

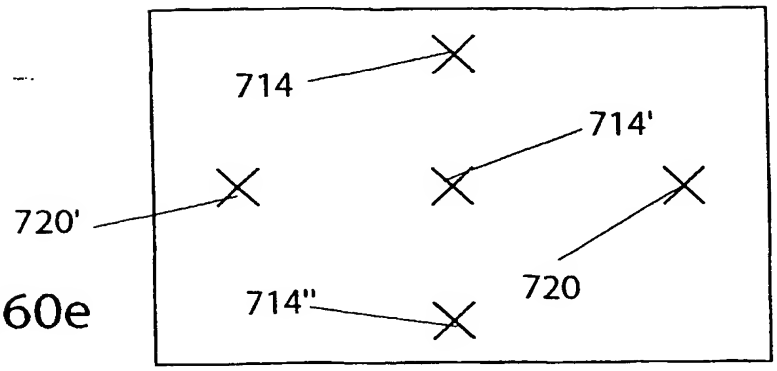


Fig. 60e

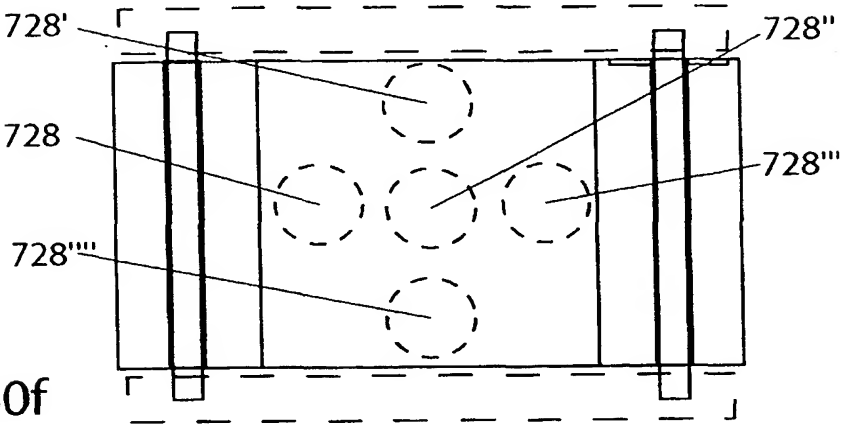


Fig. 60f

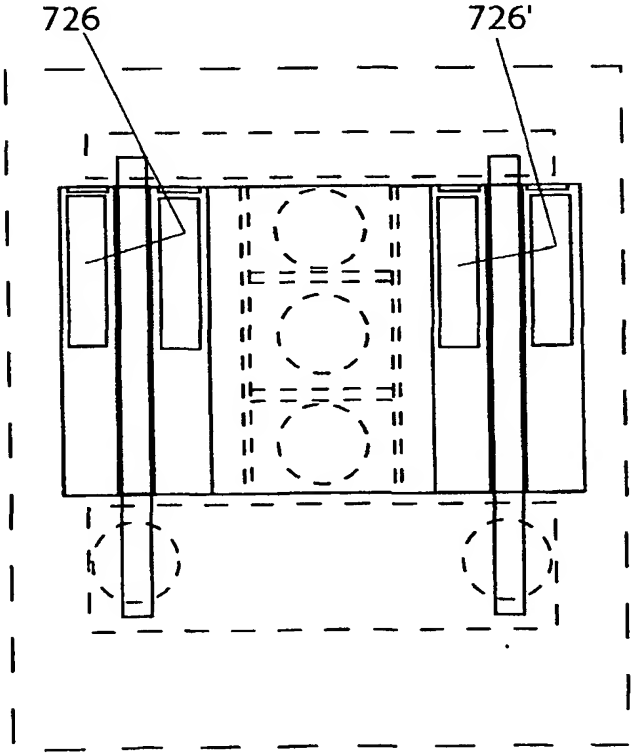


Fig. 60g

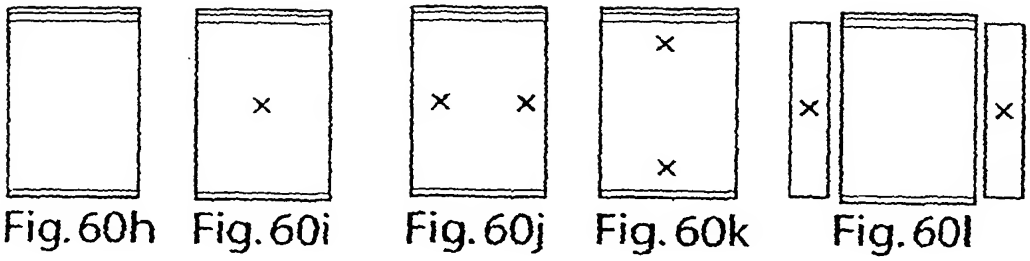


Fig. 60h Fig. 60i Fig. 60j Fig. 60k Fig. 60l

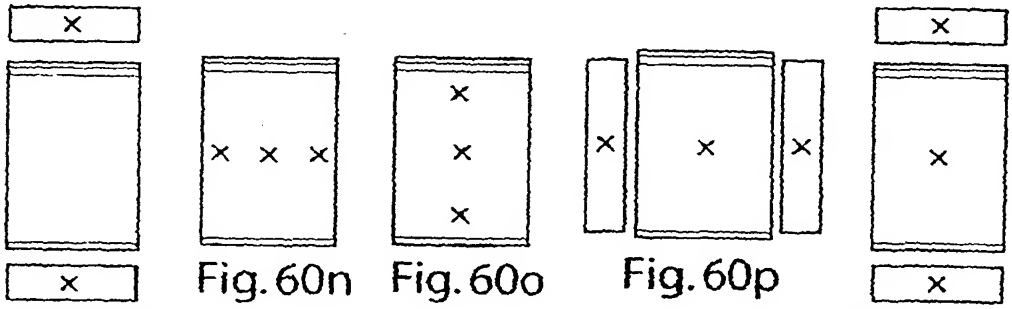


Fig. 60m Fig. 60n Fig. 60o Fig. 60p Fig. 60q

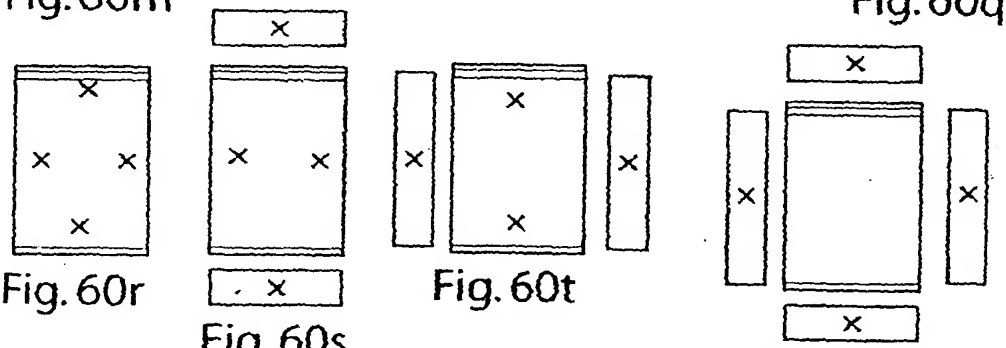


Fig. 60r Fig. 60s Fig. 60t Fig. 60u

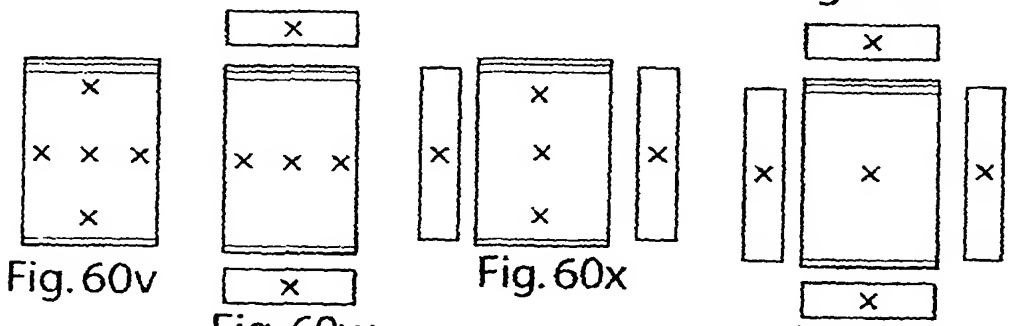


Fig. 60v Fig. 60w Fig. 60x Fig. 60y

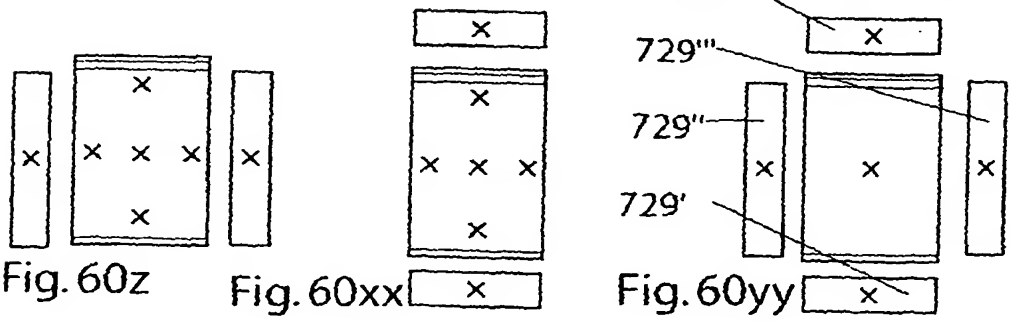


Fig. 60z Fig. 60xx Fig. 60yy

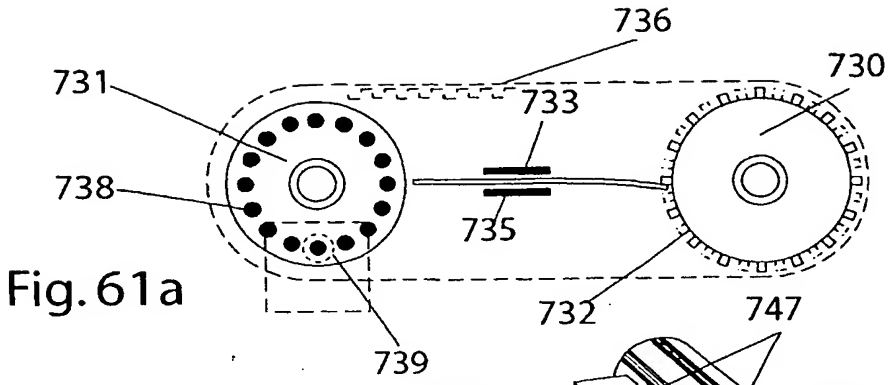


Fig. 61a

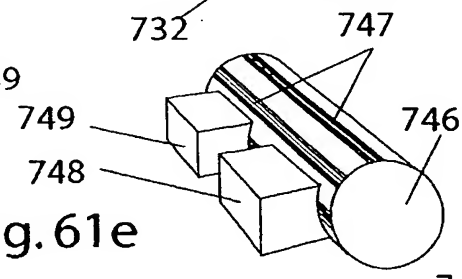


Fig. 61e

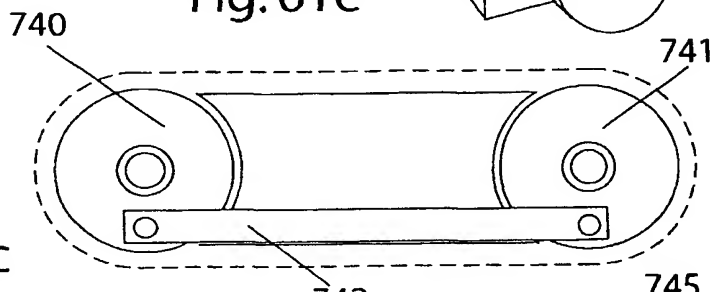


Fig. 61c

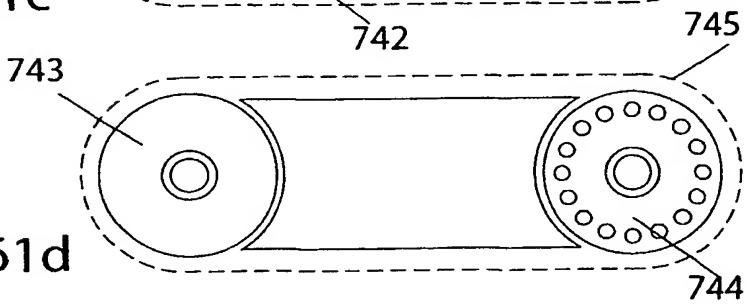


Fig. 61d

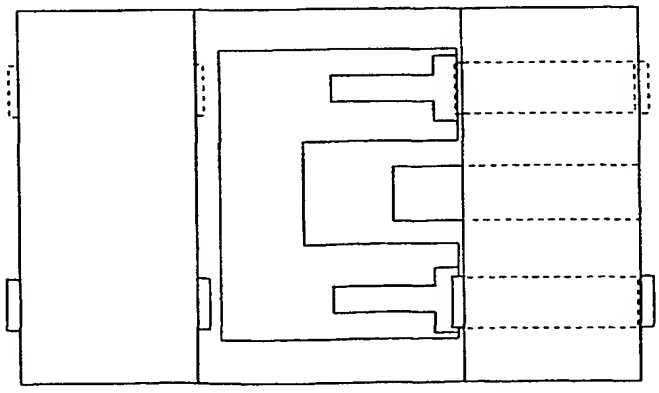


Fig. 61b

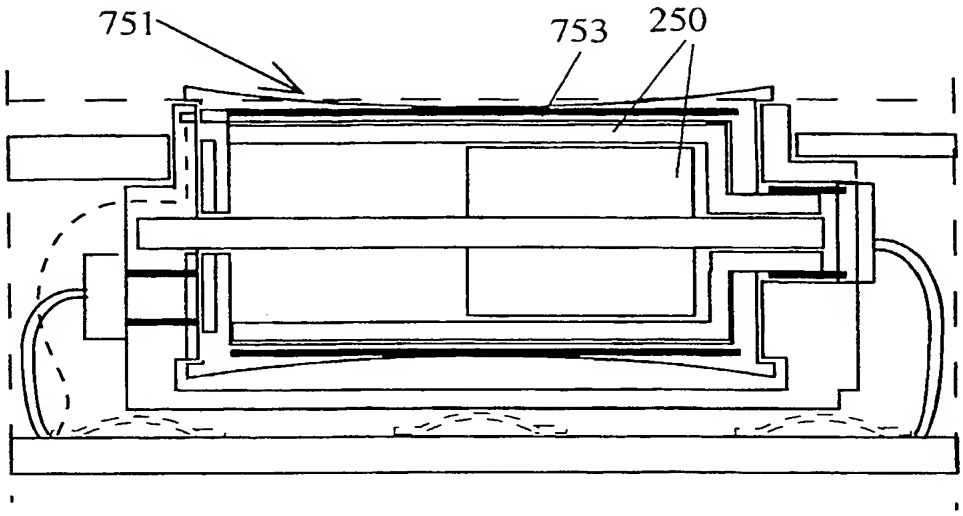


Fig. 62a

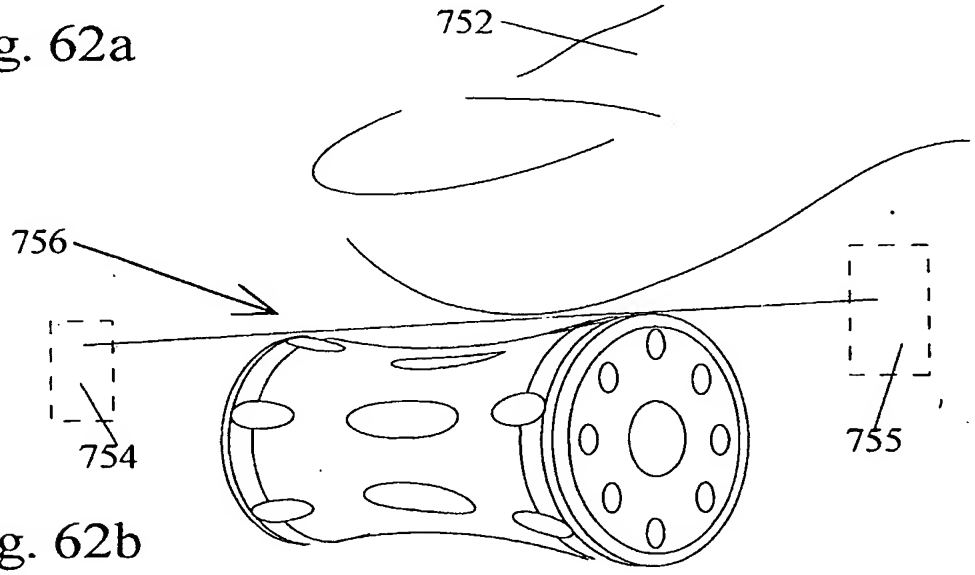


Fig. 62b

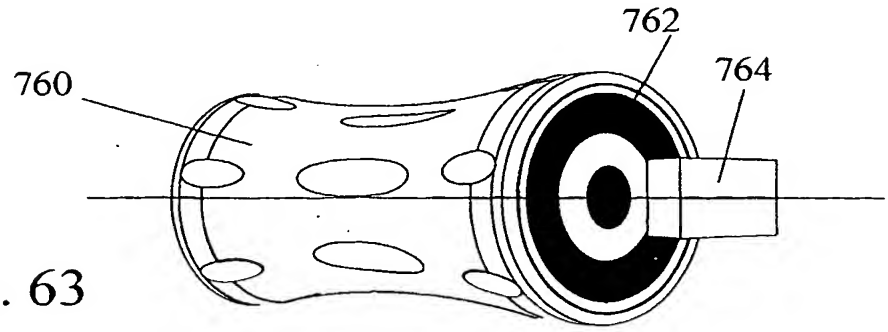


Fig. 63

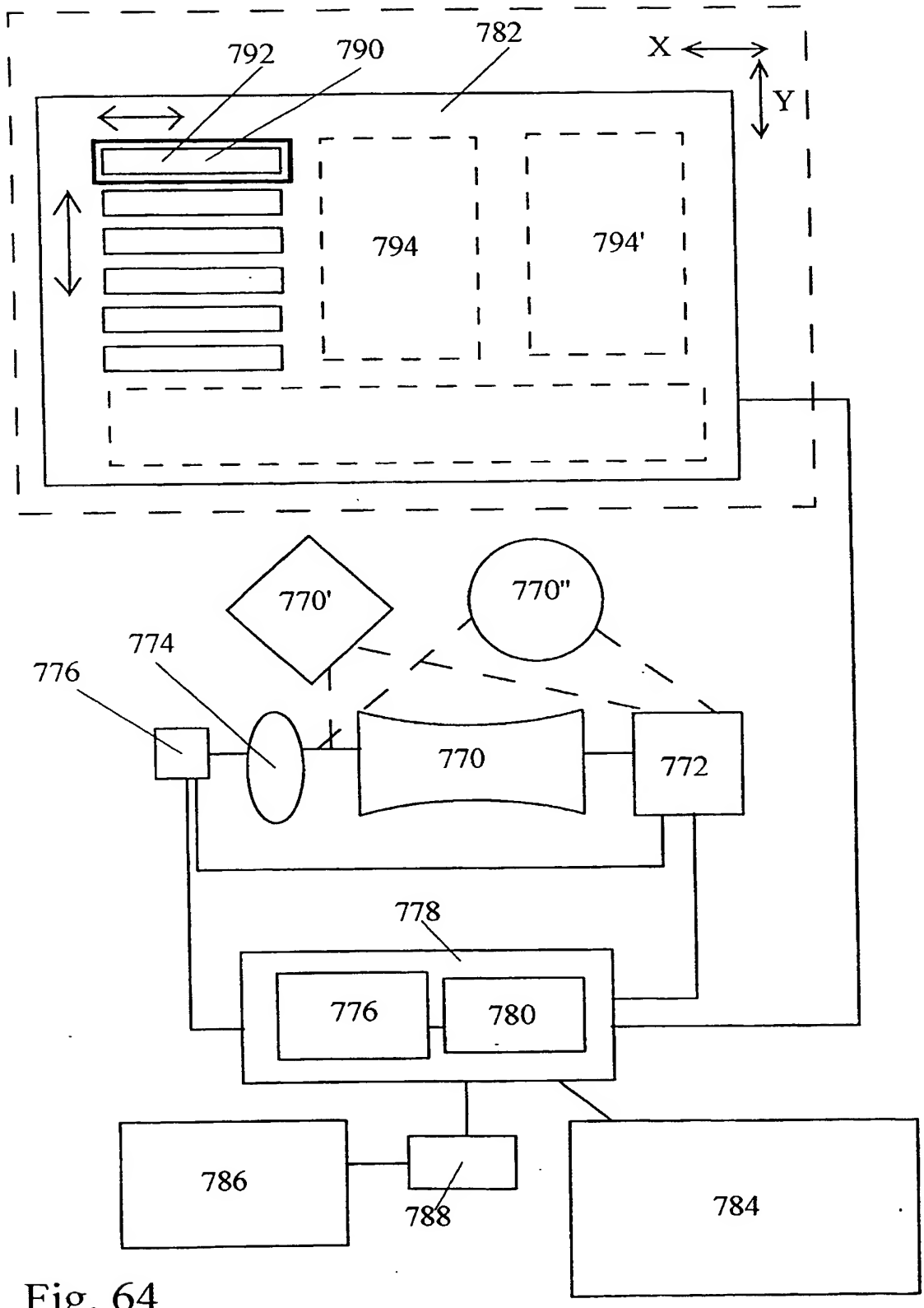

792
790
782
X
Y
794
794'
770'
770"
774
776
770
772
778
776
780
786
788
784

Fig. 64

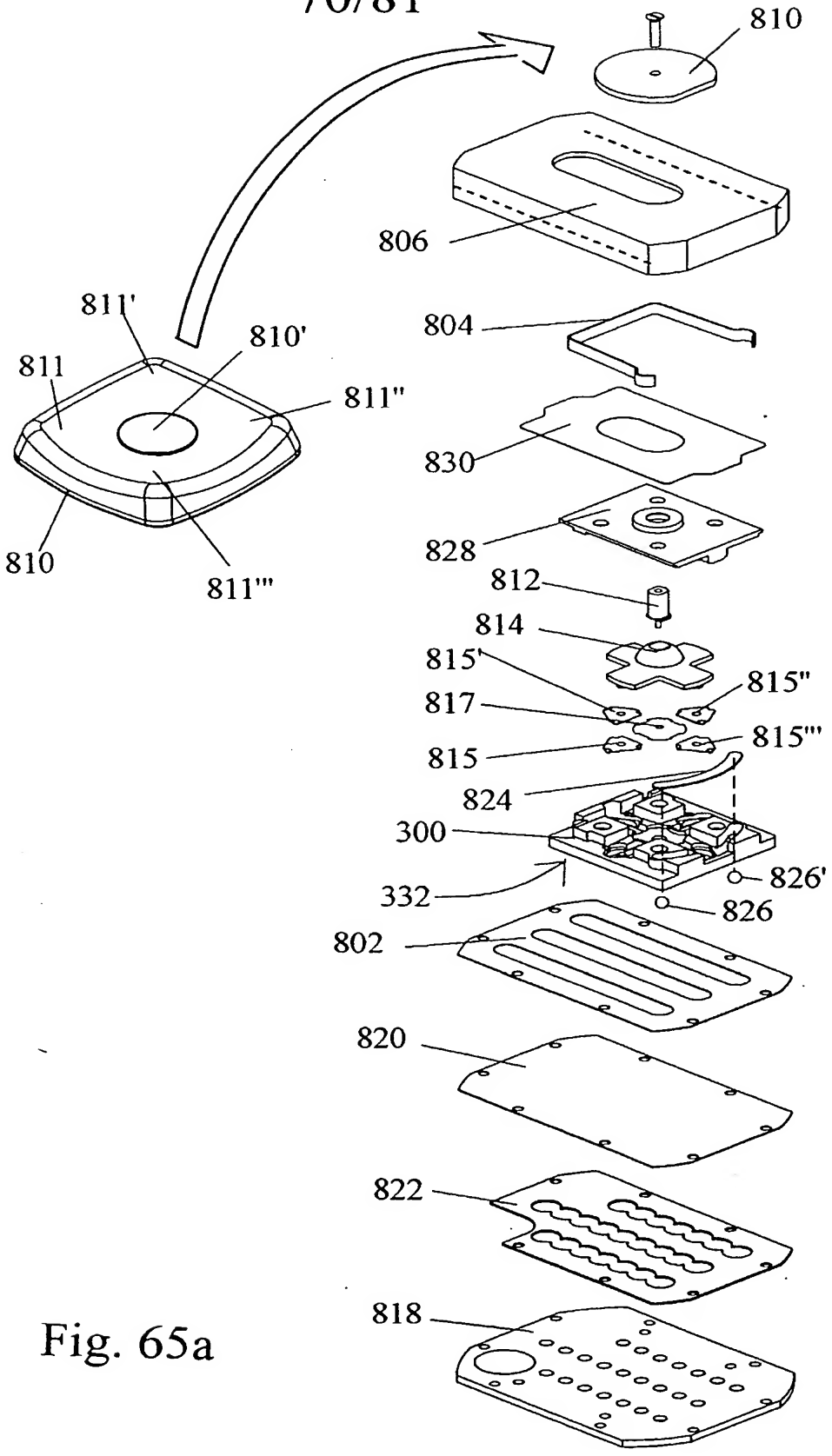

810
806
811'
810'
811
811"
804
830
828
810
811'''
812
814
815'
815"
817
815'''
815
824
300
826'
332
826
802
820
822
818

Fig. 65a

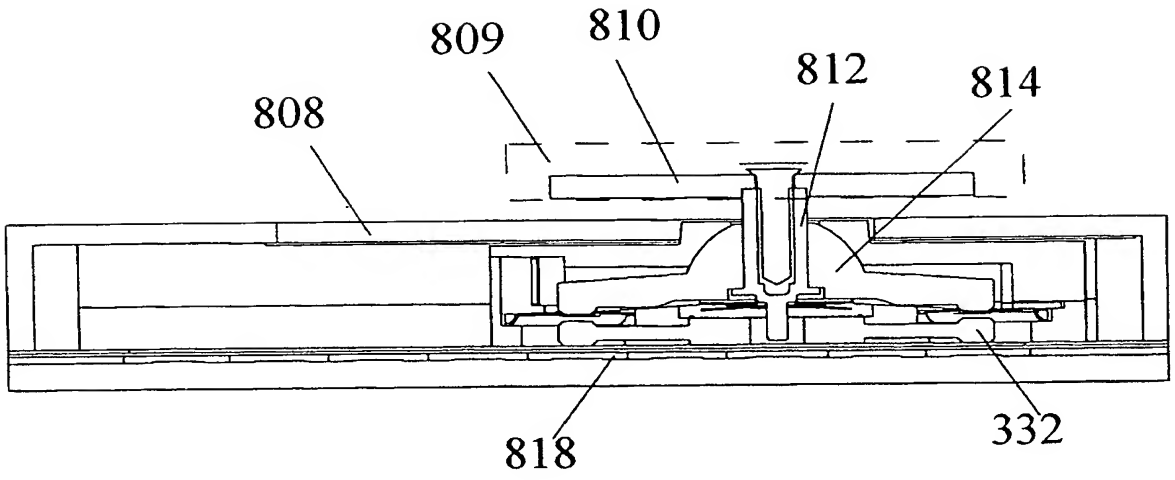


Fig. 65b

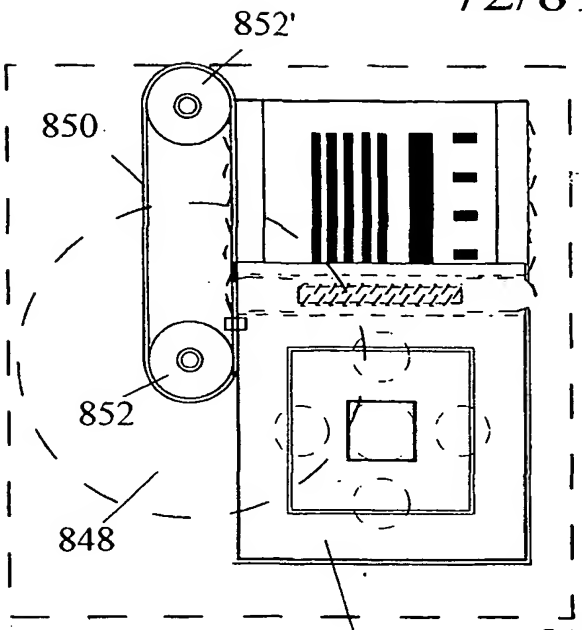


Fig. 66c

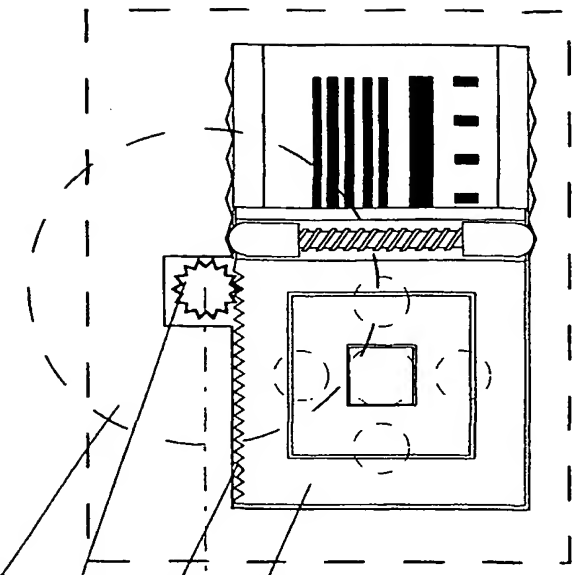


Fig. 66a

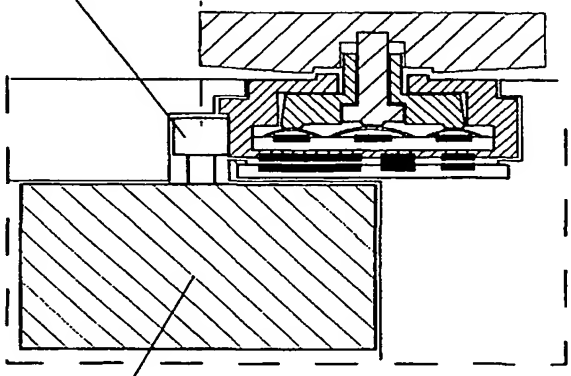


Fig. 66b

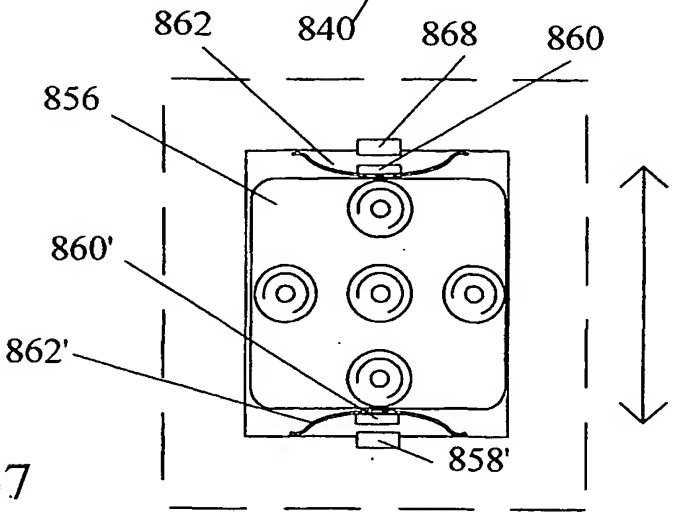


Fig. 67

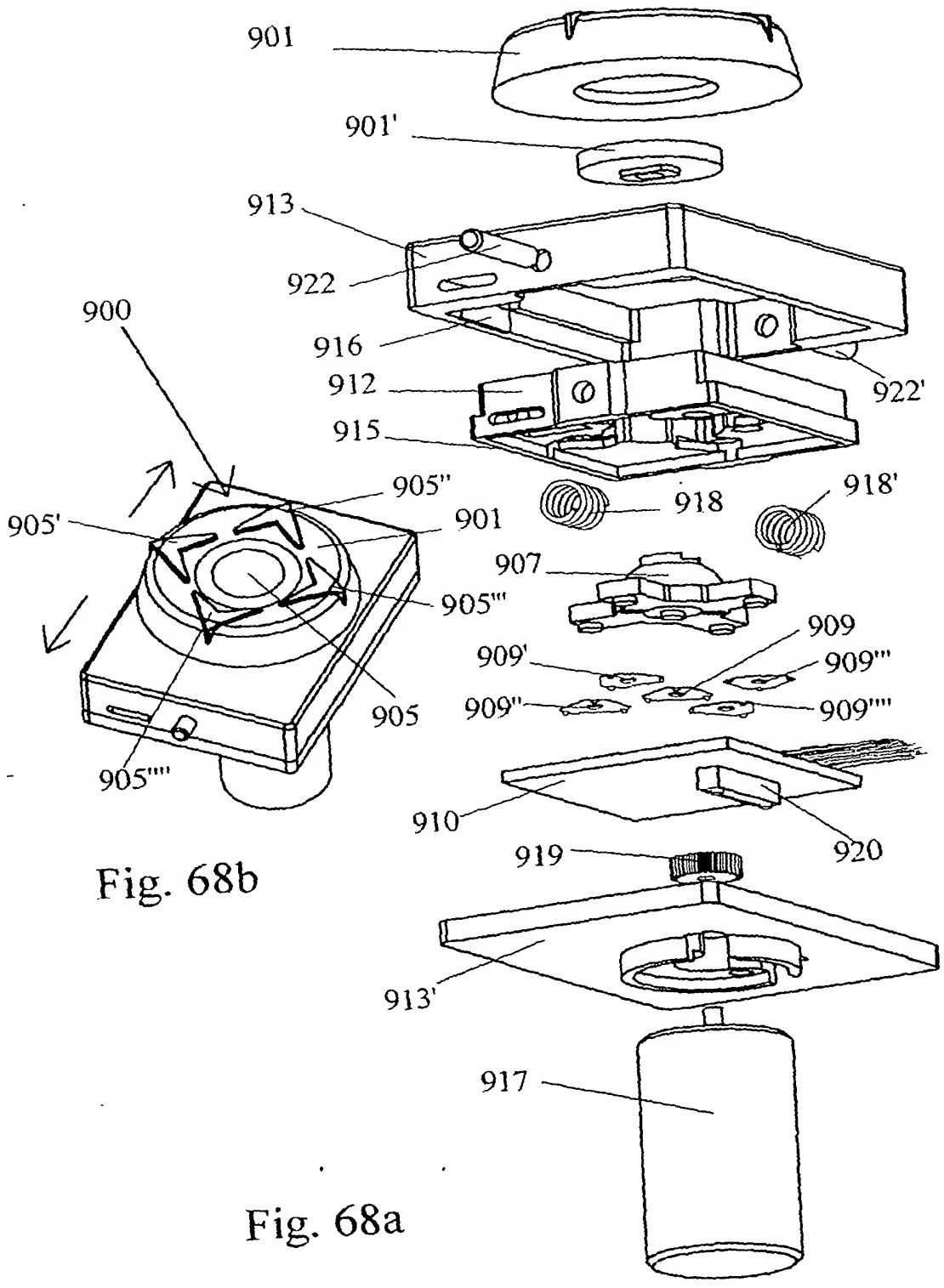


Fig. 68b

Fig. 68a

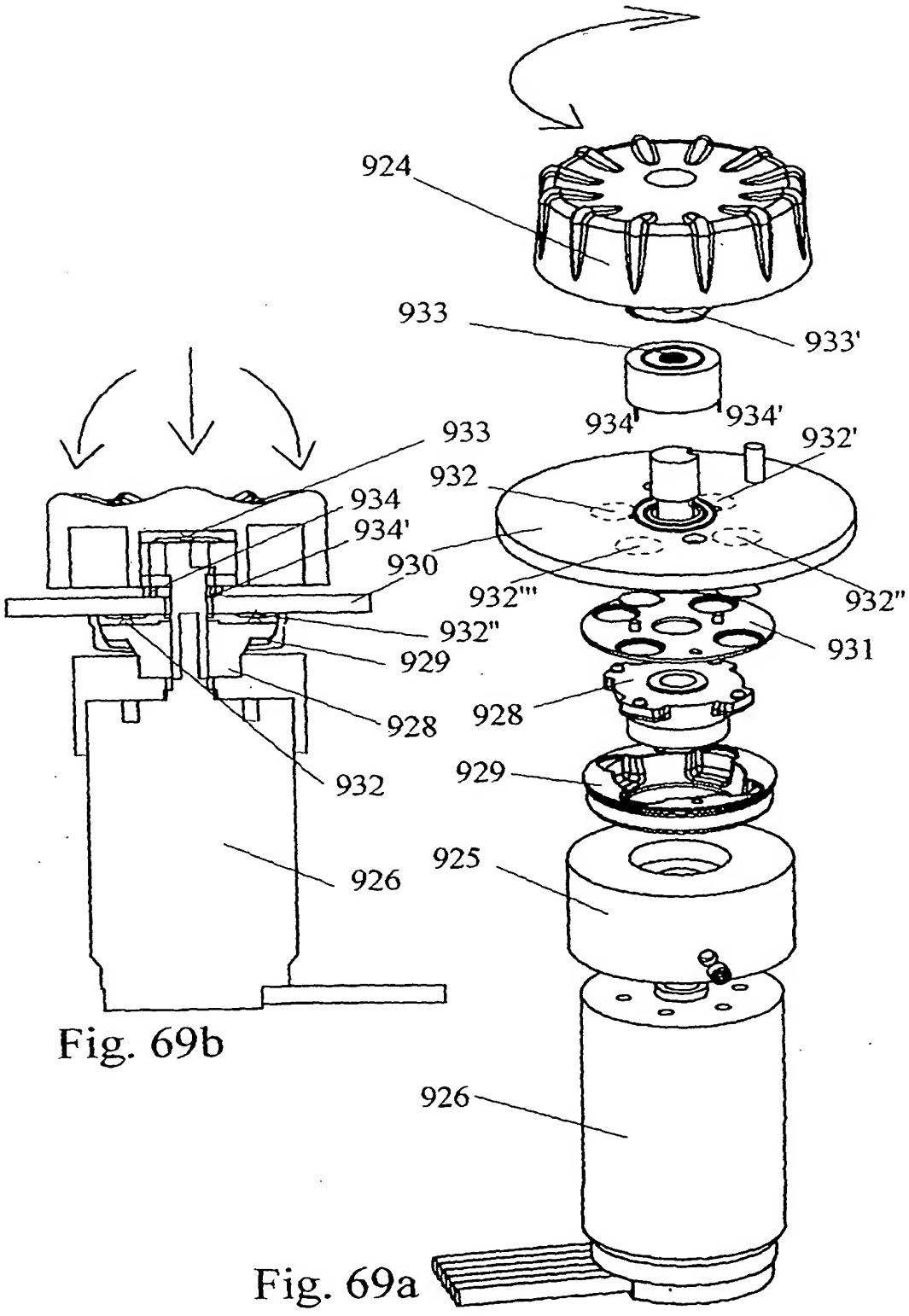


Fig. 69b

Fig. 69a

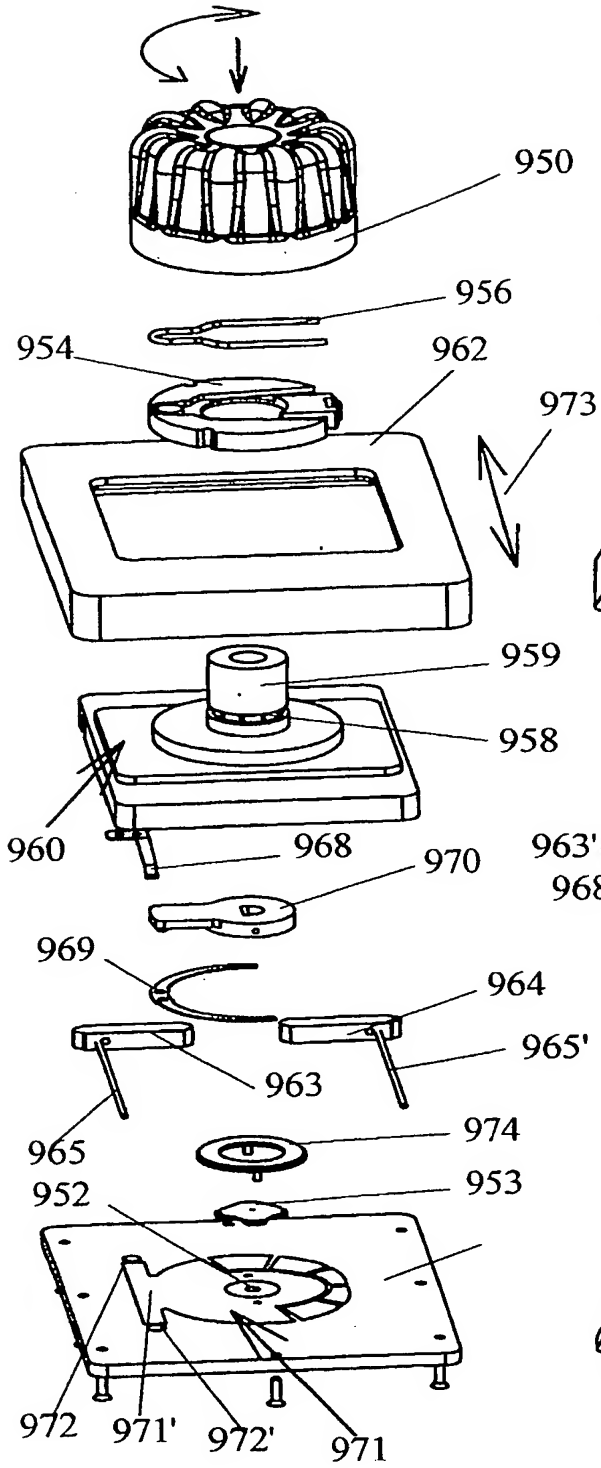


Fig. 70a

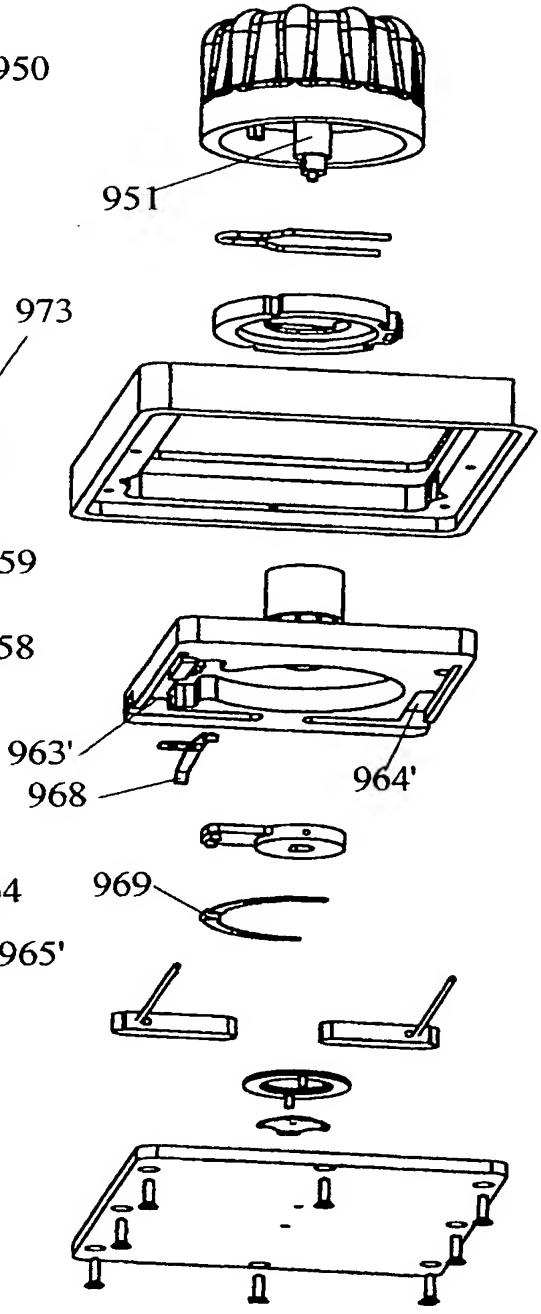


Fig. 70b

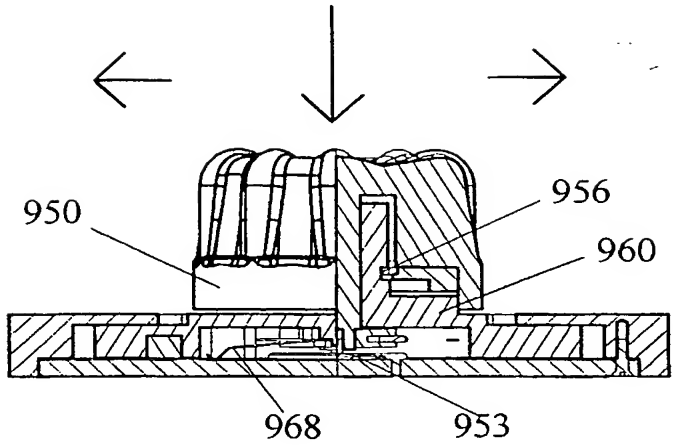


Fig. 70c

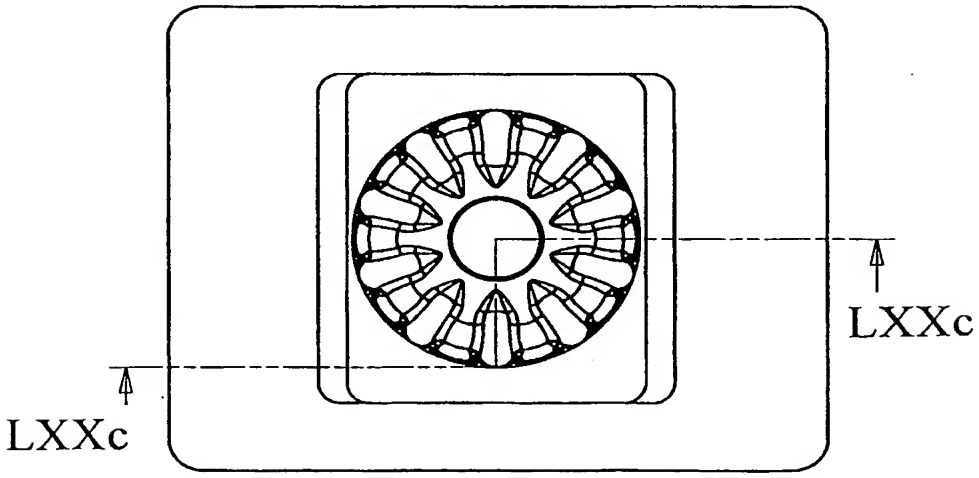


Fig. 70d

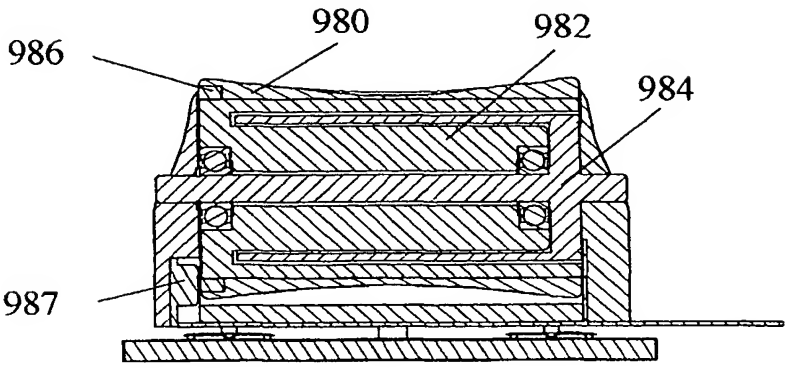


Fig. 71a

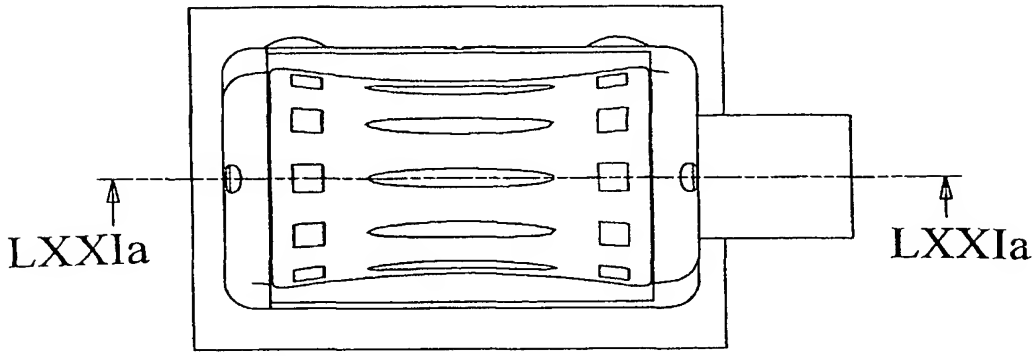


Fig. 71b

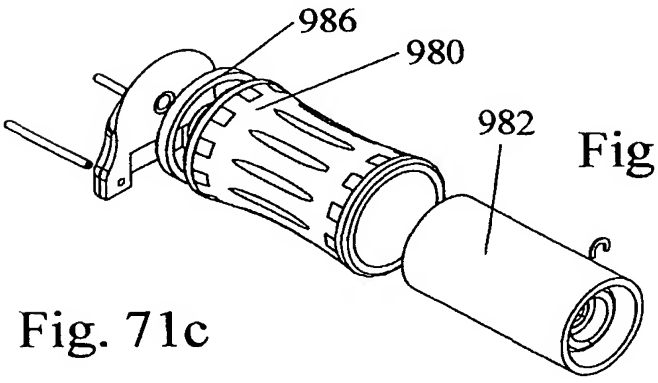


Fig. 71c

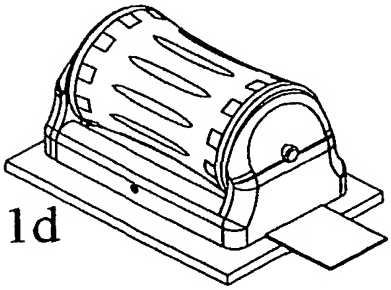
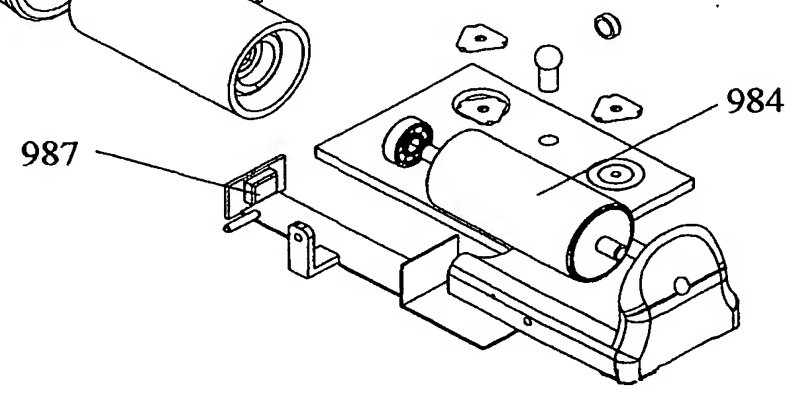


Fig. 71d



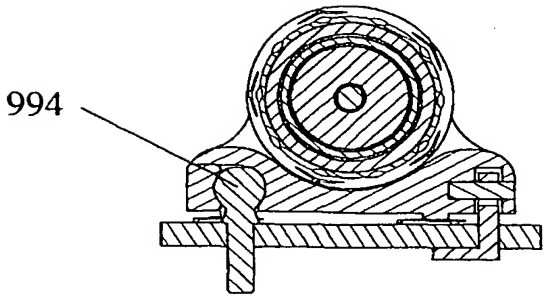


Fig. 72a

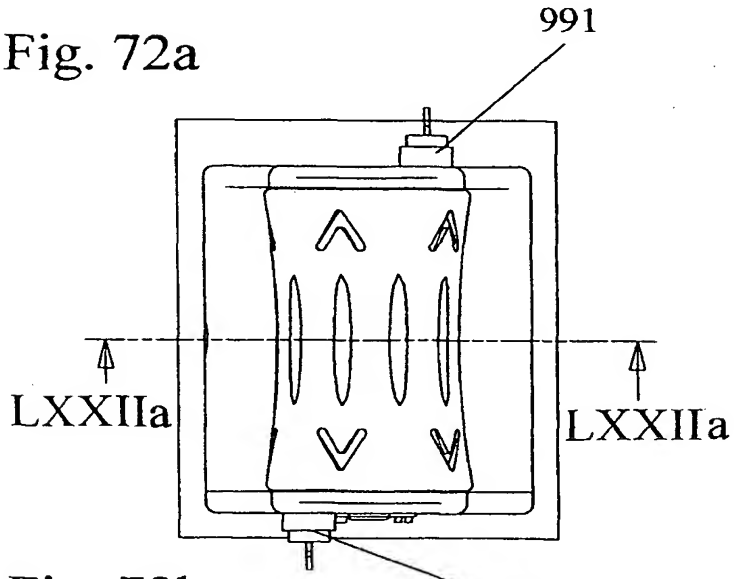


Fig. 72b

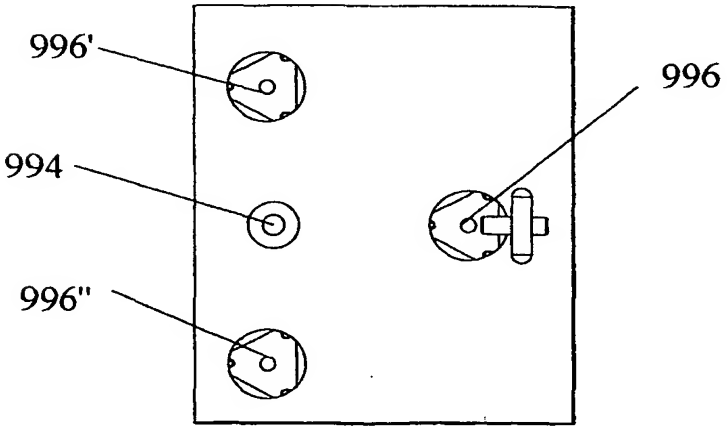


Fig. 72c

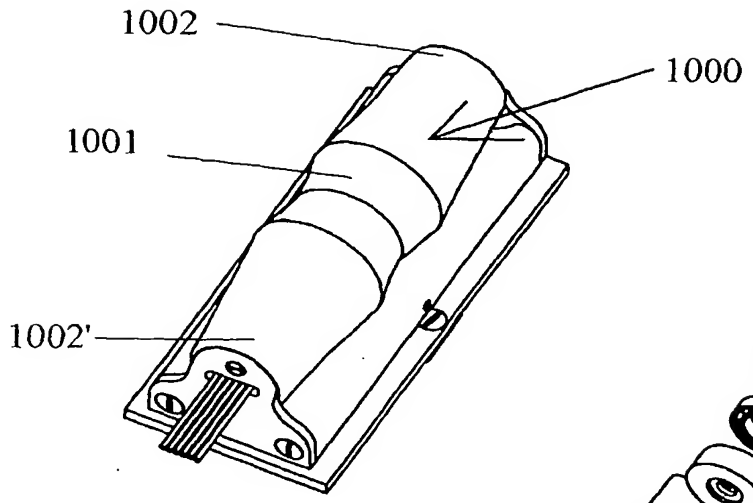


Fig. 73a

Fig. 73b

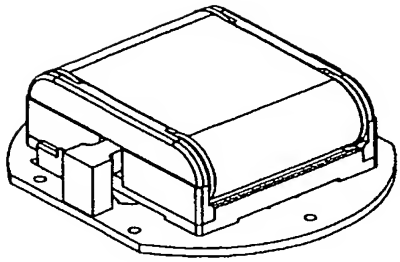


Fig. 74a

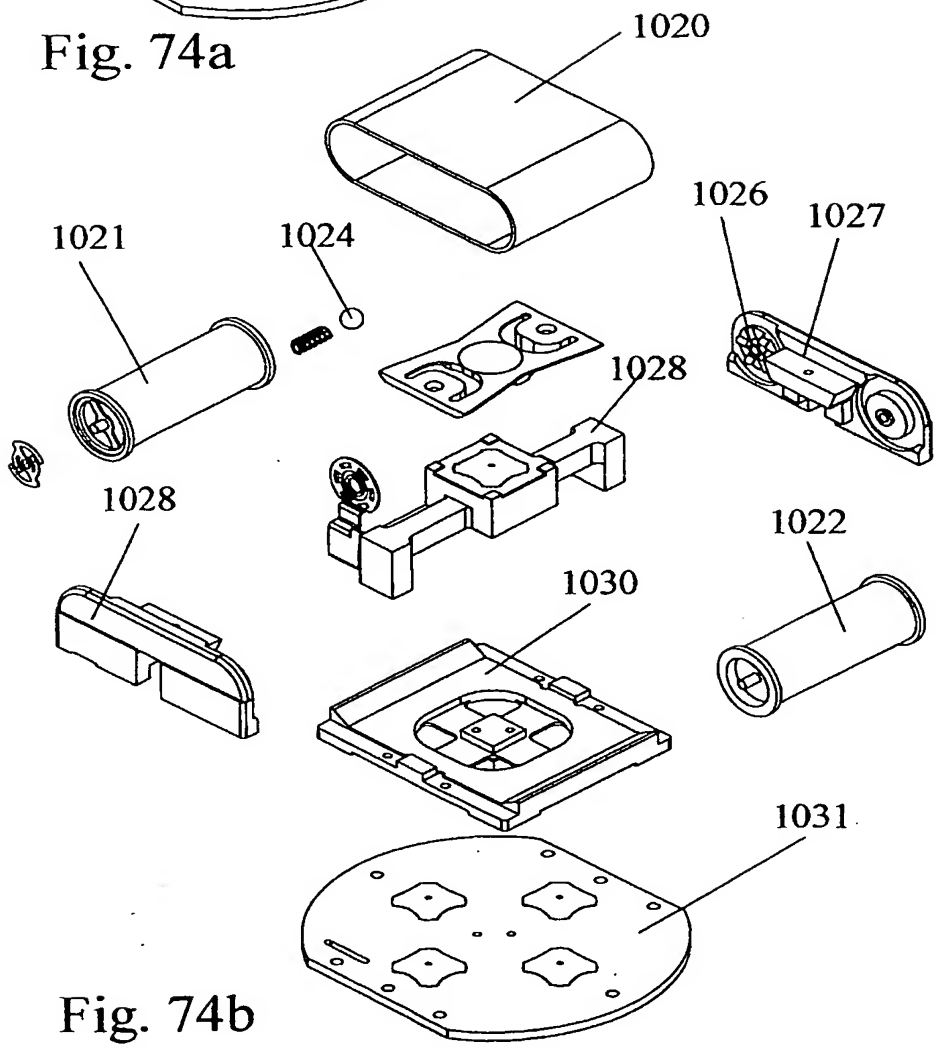


Fig. 74b

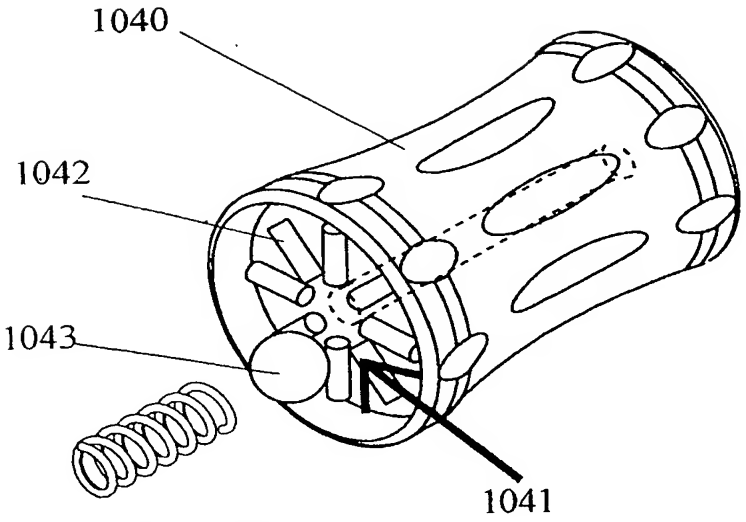


Fig. 75a

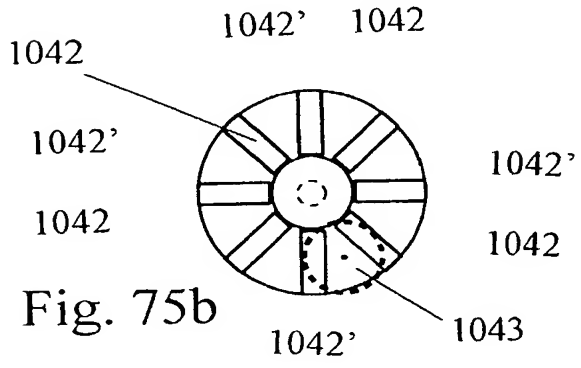


Fig. 75b

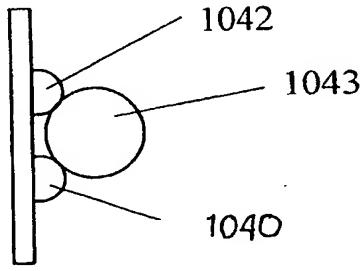


Fig. 75c

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 02/00309

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: G06K 11/18
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H01H, G06F, G06K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL,WPI,PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 0161637 A1 (BADARNEH,ZIAD), 23 August 2001 (23.08.01), see the whole document	1-49,56-61, 66,80-142
X	WO 0141053 A1 (ARMSTRONG,BRAD,A), 7 June 2001 (07.06.01), see the whole document	1-8,12-30, 42,43,56-61, 66,117-131
X	US 5504502 A (T.ARITA ET AL), 2 April 1996 (02.04.96), column 6, line 32 - line 36, figure 10	9
X	EP 0539599 A1 (FUJITSU LIMITED), 5 May 1993 (05.05.93), column 9, line 51 - column 10, line 31, figures 6A,6B	9

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 November 2002	10 -12- 2002
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Bertil Nordenberg / itw Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 1998)

BNSDOCID: <WO_____03030092A1_I_>

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 02/00309

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5446481 A (W.G.GILLICK ET AL), 29 August 1995 (29.08.95), see the whole document	31-41,45, 48-55,67,136
A	EP 0946028 A2 (NOKIA MOBILE PHONES LTD), 29 Sept 1999 (29.09.99), figures 1,3, abstract	31-41,45, 48-55,67
X	WO 0034965 A2 (BADARNEH,ZIAD), 15 June 2000 (15.06.00), see the whole document	31-41,44,45, 48-55,67, 94-116, 137-142
X	EP 1026713 A1 (MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.), 9 August 2000 (09.08.00), figures 1-5, abstract	42,43,46,56, 57,80-93, 124,125,127, 134,135
X	WO 9949443 A2 (IMMERSION CO), 30 Sept 1999 (30.09.99), see the whole document	62-65,68-79, 132,133,136

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO02/00309

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see next sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

15 inventions according to claims 1-5, 6-7, 8, 10, 11, 12-13, 14-15, 16-18 and 61, 19-21, 22-23, 44, 117-118, 119-120, 121-123 resp. 128-131 concerning an operating device comprising a tiltable slide,
one invention according to claim 9 concerning an operating device comprising a spring-supported body,
10 inventions according to claims 24-25, 26, 27-30, 42-43, 48-49, 66, 76-79, 80-88, 89-93 resp. 127 concerning an operating device comprising a tiltable and rotatable button,
5 inventions according to claims 31-41 and 134-136, 50-55, 67, 68 and 132-133 resp. 69-75 concerning an operating device comprising a roller,
one invention according to claim 45 concerning a roller,
two inventions according to claims 46 resp. 47 concerning buttons,
6 inventions according to claims 56-57, 58-60, 62-65, 124, 125 resp. 126 concerning an operating device comprising a tiltable control element,
7 inventions according to claims 94-101 and 137-140, 102-105, 106-109, 110-111, 112, 113-116 resp. 141-142 concerning an operating device comprising a belt.

INTERNATIONAL SEARCH REPORT

Information on patent family members

28/10/02

International application No.
PCT/NO 02/00309

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 0161637 A1	23/08/01	AU 3782501 A	27/08/01
		NO 20000819 A	20/08/01
		NO 20003974 A	20/08/01
		NO 20004770 A	25/03/02
		NO 20023918 D	00/00/00
		NO 20004771 A	25/03/02
WO 0141053 A1	07/06/01	AU 2043600 A	12/06/01
		EP 1236166 A	04/09/02
US 5504502 A	02/04/96	DE 69120491 D,T	14/11/96
		EP 0477098 A,B	25/03/92
		JP 2093268 C	18/09/96
		JP 4125723 A	27/04/92
		JP 7117876 B	18/12/95
		JP 2953775 B	27/09/99
		JP 4172521 A	19/06/92
		JP 2082035 C	23/08/96
		JP 4276814 A	01/10/92
		JP 8001587 B	10/01/96
EP 0539599 A1	05/05/93	DE 69230055 D,T	05/01/00
		KR 9609830 B	24/07/96
		US 5432530 A	11/07/95
		EP 0789294 A	13/08/97
		JP 7117875 B	18/12/95
		WO 9221084 A	26/11/92
US 5446481 A	29/08/95	NONE	
EP 0946028 A2	29/09/99	GB 2335822 A	29/09/99
		GB 9806325 D	00/00/00
		JP 2000036856 A	02/02/00
		US 2002080186 A	27/06/02
WO 0034965 A2	15/06/00	AU 1587400 A	26/06/00
		BR 9916038 A	11/09/01
		CN 1336037 T	13/02/02
		EP 1141983 A	10/10/01
		NO 985770 D	00/00/00
		NO 993598 A	13/06/00
		NO 994723 A	13/06/00
		NO 20012850 A	07/08/01
		PL 349069 A	01/07/02
EP 1026713 A1	09/08/00	US 6396006 B	28/05/02
		CN 1275242 T	29/11/00
		JP 2000067700 A	03/03/00
		WO 0011693 A	02/03/00
WO 9949443 A2	30/09/99	AU 3204299 A	18/10/99
		EP 1066616 A	10/01/01
		US 6128006 A	03/10/00
		US 6154201 A	28/11/00